JUL 3 1877

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

Publishing Office, No. 42 Pine Street.

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXIV.—No. 8. Whole No. 404. | NEW YORK, MONDAY, APRIL 17, 1876. | $3 PER ANNUM IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, Editor,

CONTENTS.

☞ An asterisk (*) denotes an illustrated article

EDITORIAL—
- The Gas Interest at the Centennial.....155
- Foul Lime at Philadelphia.....155
- Gas-Making in Philadelphia.....155
- Experimental Results.....156
- Death of Dr. Letheby.....156
- Acknowledgment.....156

Reports of Operations.....156
Superheated Steam.....158
The Channel Tunnel.....158
On the Sinking of a Pair of Iron Shafts for an Experimental Amber Mine.....159
Novelties in Gas Manufacture.....159
Gas-Light Intelligence.....160
Pumping Engine for the Water works of Hull, England...160
CHEMICAL AND SCIENTIFIC REPERTORY—.....160
Ferry Boat Ventilation.....161
CORRESPONDENCE—
- Wood Gas.....161
- Reply to Mr. Allen.....161
- Complimentary.....161

The Children's Hospital et al. versus Henry Bumm et al..162

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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THE GAS INTEREST AT THE CENTENNIAL.

CENTENNIAL COMMISSION.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
4 EAST TWENTY-THIRD STREET,
NEW YORK, February 2d, 1876.

SIR: It is of much importance to the gas interests of this country, that a representation of the progress of gas-lighting in America during the past century, should be made at the Centennial.

American engineers, superintendents and contractors of gas-works, desiring to contribute plans, models or drawings of gas-works or gas machinery, are respectfully notified that their contributions will be received and taken charge of by the committee of the American Society of Civil Engineers, and placed in the portion of the Centennial Buildings set apart for that purpose.

If you have plans, drawings or models you wish to contribute, please notify the undersigned at the earliest possible moment, and oblige,

Respectfully,
JAMES H. ARMINGTON,
Chairman Sub-Committee XIV,
City Gas Co., Brooklyn, N. Y.

—Or at Rooms of the Society.

FOUL LIME AT PHILADELPHIA.

We have received a pamphlet, of 167 pages, giving the affidavits of several parties upon the subject of the condition of gas purification at Philadelphia.

These include, besides the sworn statements of citizens as to the nuisance resulting from burning oyster shells and exposing foul lime, several others from eminent chemists and gas engineers in this country, which make the book a valuable contribution to the gas literature of the day. We regret that our space will not allow us to give them all at length, but we give a portion of the affidavit of Mr. Robert Briggs, C. E., Editor of the *Franklin Institute Journal*, and trust that our readers will find it interesting, as a valuable compendium of information on gas manufacture in this and other countries—particularly as regards the purification of gas. A portion of Mr. Briggs's affidavit will be found in another column. We are not as yet in the possession of the statements of the other side of the question; but we understand that this is a movement to induce the managers of the Philadelphia Gas Trust to take some measures to remove the offensive odors resulting from their course of proceedure at the Market Street works.

This is no unreasonable demand, and we are informed that already the managers have taken steps to remedy the evil at the earliest possible day.

The description, which we published in the AMERICAN GAS-LIGHT JOURNAL of March 16th, of the deodorizing of foul lime, is valuable in this connection, and we understand that some similar process will be adopted in Philadelphia.

This, together with the removal of the oyster shell trouble should satisfy the most fastidious.

GAS-MAKING IN PHILADELPHIA.

Through the courtesy of Mr. Thomas R. Brown, Engineer of the Philadelphia Gas Works, we have received a copy of the Forty-First Annual Report of the Trustees of the Philadelphia Gas Works.

We believe that this is the only gas management in this country that publishes a detailed report of their operations. Inasmuch as it is one of our largest manufactories, perhaps a few deductions from this report may be of interest to our readers. The following are some of them:

Gas made, 1875	1,873,192.000	cu. ft.
" sold, "	1,575,939,618	"
" used at works & leak'ge.	597,252,382	"
Cu. ft. of gas made per lb. of coal	4·28	
Cu. ft. of gas sold per lb. of coal	3·67	
Greatest send-out in one day	9,042,000	cu. ft.
" make " "	7,648,000	"
Coke made, 1875	6,149,423	bush.
Coke used under retorts	2,323,289	"
or 37 per cent. of coke made.		
No. of Public lamps in charge of Trustees	10,260	
No. of Public lamps, Northern Liberties Company	469	
Total	10,729	

Lime used, 491,124 bushels.

Number cu. ft. purified per bushel, 3,814.

Average candle power for the year, 16·61 candles.

During the year 217,312 lineal feet of street mains were laid, making a total length of miles.

In the item of unaccounted-for gas, no distinct items are given, by which to separate the gas used about the works, offices, etc., from that which was actually lost. We hope the time is not far

distant when some form of report will be devised that will enable gas makers to make up a statement, showing the main features of the operations of all the companies, so that each can know exactly what results are being obtained with reference to others. The Philadelphia Works being a public concern, the law requires a report of operations. We do not claim that other works belonging to corporations are under any obligations to publish their business, any more than an Edge Tool Company, or a Woolen Manufacturing Company; but what we claim is this—that if gas makers could agree on some form of statement, as to their practical workings, for use amongst themselves, it would do much to secure progress, economy and success in the manufacture of gas. We would not discuss the matter of profits, for this a matter upon which people differ. Of one thing we are confident and that is that if an iron mill, a woolen mill, or any other business in which men usually put their money, is not able to show a profit of 25 per cent., it is not considered a very desirable property; even the retailers would look upon that as little enough in the gross. All that any corporation is obliged to publish is a statement such as will show the soundness of their condition, viz.; their liabilities and assets. No fault is found if a successful mining company, or a publishing company, pays 80 or 100 per cent. per annum, but if a gas company pays 10 per cent. they are "extortioners." A well-managed gas company must be rebuilt about once in ten years, and provision must be made for this over and above the stockholder's dividends. And still some people expect gas to be furnished to consumers, at actual cost of manufacture, with perhaps 5 per cent. dividend, and as much more carried to reserve. But the worst feature of it all is that if this was actually done, many people would still be dissatisfied, and would find just as much fault as ever.

EXPERIMENTAL RESULTS.

In our last we referred to the tabular statements presented in our report of the New England Association, of some experimental workings at Boston. We said that from such statements as this, information might be derived which could be made available in improving results. A great deal of discussion is carried on nowadays, about new methods of gas making, but it is not our purpose to discuss these now. The result of all these endeavors to find some better way of making gas than from coal, ought to be to set coal gas men to thinking, and working, in order that they may know whether they are doing the best they can with coal; and here we must say that we think not.

Being fully aware of the difference between sitting here and writing about what some one else has done, or is doing, and going into the retort-house and doing better ourselves, there is one idea that persistently remains in mind, after studying Mr. Lamson's tables—and that is that the whole available product of the coal is not obtained. We see, from these tables, that as we approach the maximum yield, there seems to be almost an exact inverse proportion between the yield and the candle power. Like a strip of india rubber, the more you stretch the length, the narrower it becomes. If this is so—have we got the maximum yield that we can take out, and still, by adding enrichers, make up the required candle power with economy? Let us see. If we take 90 per cent. of Penn coal, with a yield of 5·14 to the pound, of 13·41 candle power—and 10 per cent. of cannel, yielding, say 4·50 to the pound, of 35 candle power—we shall have a result giving 5·08 to the lb., of 15·75 candle gas. Or, again, using 85 per cent. of Penn, giving 5·14 to the lb., of 13·41 candle gas, and 15 per cent. of cannel, giving 4·50 to the pound, of 35 candle gas, we get a result of 5·04 feet to the pound, of 16·65 candle gas; this certainly would be good enough as far as *quality* is concerned, and no doubt the yield would to-day be considered good. But Mr. Lamson speaks of one case where he got a yield of 6·38 to the pound, of 10·91 candle power, and adds—"Air was of course drawn in."

Now, if the proportion referred to above is a true one, we cannot see how this result differs from those in the table; for, if 5·14 to the pound gives 13·41 candle power, what would 6·38 feet to the pound give?—by proportion, we should have about 10·83 candle power, from which we must argue that the air got in *very* slightly. But whether the air got in or not, let us see how much cannel it would take to bring the candle power of this up to the standard. Taking a mixture of—

80 per cent. Penn—
Yield 6·38 feet per lb. of 10·91 candle gas,
20 per cent. cannel—
Yield 4·50 feet per lb. of 35 candle gas
would give a—
Yield 6 feet per lb. of 15·73 candle gas.

From this it is seen that it is simply a question whether the increased yield pays for the additional cost of the cannel. It is easy for any one to figure this out for himself.

We find that for a candle power of 15·75 (in table) the yield was 3·89 from Penn coal, which would be 8,714 feet to the ton; this, for coal, would cost $6, or about 69 cents per M. Taking the mixture yielding six feet to the pound, of 15·73 candle gas—

80 per cent. Penn would cost....	$4·80
20 " cannel at $10 "....	2
Total.....	$6·80

for which we get 13,440 cubic feet of gas, or about 50 cents per M.

Now, just here, the remark comes in—"You can do this on paper, but you can't do it in our works,"; all of which we admit, *but* we still insist upon it that the sooner the works are put into such a condition that it can be done there, the better for all concerned.

The experimental works in Boston are on a regular working scale of what is sometimes spoken of as a six inch works—that is, the connections are six inches. If it can be done there it can be done elsewhere.

But the leaks must be stopped, and old worn out apparatus replaced by new, and things cleaned up generally and put into something like *working* ORDER. We do not wish to make absurd statements, but really this matter is worth considering. Let no gas maker be satisfied with standing still. Progress must be made; and we really believe that if half the time and money spent in devising new patent processes, had been expended in getting all that was *available* out of the old ones, the Science of gas-making would to-day be far in advance of where it is.

DEATH OF DR. LETHEBY.

Since our last the sad news comes to us of the death of Dr. Letheby. No man in England has taken a more prominent place in the many scientific investigations, regarding the manufacture of gas during many years past, than he.

His loss will be most keenly felt by our friends across the water, in whose behalf he has so faithfully labored. It is a matter of consolation that, through the valuable pages of the *Journal of Gas Lighting*, we have preserved many of the valuable results of his labors. We are sure that in extending to our brethren in England our heartfelt sympathy for their loss, we but speak the sentiment of every true student of the science of gas-making in this country, who, we doubt not, will claim a share in the loss with which our English friends have met, and from which the scientific world at large must suffer.

ACKNOWLEDGMENT.

In our issue of last week we published an article, by Bishop Clark, of Rhode Island, on "Light as a Symbol." It should have been credited to the *New York Ledger*, but we regret to say that the omission escaped our notice until too late to remedy the defect. Accidents, will happen, etc., and if this one only results in making our compositors more careful in this respect we shall be satisfied.

Reports of Operations.

In our last issue we ventured to make a few suggestions, with reference to the various subjects that might with advantage be discussed at the next meeting of the American Gas-Light Association. While we offer these suggestions purely in the interest of the advancement of the science of gas-making, we would not be understood as desiring in the least to interfere in any way with the free action of the managers or members of that institution. If there is any benefit to be derived from societies of this kind, it is in the facility which they afford for comparing results. In order to do this intelligently, it is necessary to have a systematic collection of facts all arranged on the same basis. We have just received, through the kindness of our friend, D. Bruce Peebles, Esq., of Edinburgh, a report of the meetings of the West of Scotland Association of Gas Managers, in 1875, and also a tabular statement of the returns made by each gas company in Scotland, upon a form provided by the Society.

We give the headings of this table, and an inspection of it will show how thoroughly our Scottish brethren go into these matters. Our space does not permit us to reproduce the report as made up from these returns; but it can be readily seen how easy it would be for any gas manager to take a paper in which was contained the answers to the following questions, from every company, and compare his own workings with those of others. And when he sees that in regard to any point he is behindhand, he knows just which way to direct his efforts to improve his manufacture. The report to which we refer is arranged under 23 heads, as follows:

1. Name of town.
2. Population.
3. Manager.
4. Area of carbonizing surface—sup. feet.
5. Pressure on retorts—inches.
6. Area of condensing surface—sup. feet.
7. Capacity of condensers—cub. feet.
8. Capacity of scrubbers—cub. feet.
9. Area of washers—sup. feet.
10. Total area of purifiers—sup. feet.
11. Purifying materials—
    - Oxide of Iron { Trays, No. / Total depth, inches
    - Lime { Trays, No. / Total depth, inches.
12. Capacity of holders—cub. feet.
13. Maximum daily make—cub. feet.
14. Annual manufacture—cub. feet.
15. Length of main per consumer—yds.

16. Average consumption of gas per consumer—cub. feet.
17. Average night pressure on mains—inches.
18. Average day pressure on mains—inches.
19. Leakage, or unaccounted-for gas—per cent.
20. Illuminating power—standard candles.
21. Price per 1000 cu. ft. to consumers.
" " " " " public lamps.
22. Meter hire per year.
23. Gas works owned by—
24. Remarks.

In the proceedings of the West of Scotland Association of Gas Managers this matter was fully discussed, and the method of calculating the different areas fully explained. We give an extract from the proceedings on this subject.

ANNUAL REPORT.

The Chairman said that the next business before the meeting was the annual report; and he might say that some new questions had been added, the effect of which would be to make the report of more benefit to gas managers in general, and to all gas companies. The best way to deal with the queries would be to go over them *seriatim*, and as he read, if there were no dissentient voice, he would hold the report as adopted. The questions were as follows:

(1) Town, (2) Population, (3) Manager, (4) Area of carbonizing surface. We have a rule here for the guidance of gas managers, and it is this: The area of carbonizing surface is the total internal surface of retorts sufficiently highly heated to produce gas. Thus, a retort, say, heated for 8 feet of its length, and having a circumference of 4 feet, would give 8x4=32 feet carbonizing surface, and nine such retorts would give a total of 288 superficial feet. (5) Pressure on retorts. That is, pressure on the hydraulic mains, with the amount of dips on stand-pipes added. That can easily be ascertained by placing the pressure-gauge on the hydraulic main. (6) Area of condensing surface—condensing surface to embrace hydraulic mains, condensers, and all pipes connecting the same; or, in other words, all surfaces by which the gas is reduced in temperature. Thus, say hydraulic main, 30 feet long by 5 feet circumference=150 feet; piping from hydraulic to condensers, 20 feet by 2 feet equal forty feet; pipes, 180 feet by one foot six inches equal 240 feet; chest, 8 feet by two feet by one foot six inches equal 62 feet; total condensing surface, 362 feet. I may add that we merely give out something for a small work; but with this statement any one will be able to do the work properly.

Mr. Niven—I think it might do quite well to take the condensing surface from where it leaves the hydraulic main.

After some further conversation—

The Chairman said—There are no other objections to this rule, and there is only the recommendation of our friend from Airdrie that the area of the hydraulic main be dispensed with. In the instruction we will insert "from the hydraulic main," and that, I think, meets the views of most members present. The 7th question has reference to the capacity of condensers. The capacity of condensers is the quantity of gas required to fill all parts of the apparatus in which the gas is cooled. This may be ascertained by a calculation, thus:

Hydraulic main, 30 feet long; area of space above water-line, 1·25 feet=37·5 cubic feet; pipe from hydraulic to condensers, 20 feet long x·50 feet area=10 cubic feet; condensers, pipes 180 feet long x·28 foot area=50 cubic feet; total, 113·5 cubic feet. This is merely the quantity of gas required to fill the apparatus from the hydraulic main till it leaves the condensers, including box and everything. It is the internal measurement.

Mr. Young—The object of the former question is to ascertain the surface, and of the present one to ascertain the capacity of the condensers. Suppose we have two sets of condensers, one with a small and the other with a large internal capacity yet having the same cooling surface—say, in the one case, the condenser was composed of 4-inch and the other of 8-inch pipes—it is evident, that, for equal areas of surface, there will be only half the capacity in the smaller pipes, and that in passing equal quantities of gas through both sets of condensers, the gas will require to pass at double the velocity through the smaller-sized pipes; and, consequently, although we have the same cooling surface, yet we have not the same condensing power, for we all know that gases, when kept in rapid motion, have the power to carry forward tarry particles mechanically suspended, and that unless they get rest somewhere these particles are not properly deposited. Where there is a condenser of large internal capacity, the gases travel so slowly that at each turn of the chest they deposit their tarry particles; whereas, if they are driven with great velocity, they swirl round and carry on the tarry deposit, and some of the material which should have been removed by the condensers would find its way to the trays of the purifiers, close up the lime, and prevent it having its proper action on the gases.

The Chairman—The next question is as to the capacity of scrubbers. The capacity of scrubbers is the cubic contents of the vessel, so far as it is filled with coke, boarding, or other material over which the water is spread to bring it into contact with the foul gas. Thus, say the scrubber is 12 feet high, and filled with coke 10 feet, and, diameter, say, 4 feet; then 4 feet x 4 feet=16 x ·7854 =12·57 x 10=total, 125 cubic feet. Of course, it is not the full internal capacity of the scrubber, but only from where the water comes into contact with the crude gases. The next question is as to the area of washers. The area of washers is the superficial area of the plate for distributing the gas and causing it to come into contact with the water. Thus, say a round washer having a plate 5 feet in diameter 5 x 5=25 x ·7854=19·63 superficial feet.

The next question is as to the total area of purifiers. The area of purifiers is the superficial area of the top trays in all the purifiers. Say there are two purifiers, 8 feet x 6 feet. That would give 48 feet as the superficial area of each purifier. Two such purifiers would give a total area of 96 superficial feet; and say each purifier is provided with four trays, two of which are used for oxide of iron and two for lime, and that each material is placed on the trays to the thickness of 6 inches, then there would be four trays for oxide of iron, with a total of 24 inches, and four trays for lime, with a total thickness of 24 inches. There has been some misunderstanding with regard to the depth of lime used. Some argued that it was the depth of one purifier, whereas it was the depth of the whole material used. The following questions have reference to the capacity of holders; the maximum daily make—that is, the greatest amount made in 24 hours; annual manufacture; length of main pipe per consumer—that is, to get the length of the mains divided by the number of branches you have, and this will be very valuable if it can be accomplished. It will be very easily done where there are survey maps.

Mr. Young—And where there are no maps, there will be few managers unable to spare time to step over their mains and arrive at a pretty correct result.

The Chairman—The next is—Consumption of gas per consumer—average night pressure on mains; and that has a good deal to do with the unaccounted-for gas. This return will be a very important one, if the members will kindly fill up the schedules. I do not suppose there will be any gas-works without pressure-gauges. Their average day pressure on mains, leakage, or gas unaccounted-for.

Mr. Young—These three questions bear on the leakage very materially. In the first place, we have the length of main and few consumers, we must have an extra amount of leakage. Then, in cases where the pressure has to be kept on during the day, to fill a gasholder placed at a distance from the works, the leakage, as we all know, is in the exact ratio of the pressure; and, consequently, from this cause, the leakage would be much increased. It is also material that we should have the average day and night pressure, as in many cases gas managers have not the power to check pressures. I was much struck, in this connection, with the state of Stirling. At the bottom of the hill on which the town stands they are working from 5 to 7-10ths pressure, and yet at the top they have some three or four inches. As, with these gradients, a great number of governors are required to equalize the pressure, there will be great leakage in the upper half of the town as compared with the lower half, unless a series of governors are employed to reduce and equalize the pressure.

Mr. Richmond—In small works, such as ours at Whitburn, there are no governors.

Mr. Brodie—I think that the society should impress upon every member the importance of having governors, because there is not the slightest doubt that these small works which have no governors by getting them would save their price in a year.

Mr. Richmond explained the difficulty under which he labored in having to keep a holder, situated about two miles away, constantly full, and said that he was under the necessity of keeping up the pressure night and day.

Various means of remedying the defect were suggested, but some of them Mr. Richmond had tried, and found them to be unavailing.

Mr. D. Keith (Barrhead)—We had a holder such as Mr. Richmond speaks about, which was filled during the daytime. The connection was by a two inch pipe. Well, we lifted that pipe, and laid down a four-inch pipe, and the price of these pipes was saved in a year. If at Whitburn they were just to double or treble the size of the pipes, they would effect much good.

Mr. Richmond—That is my idea; but the distant holder belongs to a different company, and there is some difficulty.

Mr. Brodie also spoke as to the great saving in regard to leakage which would be effected by putting on governors.

The Chairman—The next question is leakage, or unaccounted-for gas. In making this calculation managers are to add to the gas registered in consumers' meters an estimated quantity as used in the works, and by deducting these from the gas made, the desired conclusion can be easily arrived at. The next question is the price per 1000 to ordinary consumers and to public lamps as at the 31st of November. We will get these printed and issue them to all the gas works in Scotland, and trust that managers will use their best efforts to afford reliable information.

THE FRENCH ACADEMY OF SCIENCES disburses annually 110,000 francs in prizes to men of science to stimulate their endeavors and supply the pecuniary means for further researches.

Superheated Steam.

Erom "The Engineer."

If low-pressure steam is to compete in economy with high-pressure steam, it must be used under special conditions. The experience of more than a fourth part of a century has proved unmistakably, that with saturated steam of 25 lb. absolute pressure, or thereabouts, cut off at half-stroke, in large unjacketed cylinders, we cannot get a horse-power with a much smaller consumption than 5 lb. or 6 lb. of coal. In the face of this fact, it requires, we admit, some temerity to argue that it is possible to work an engine with steam of no great pressure on a consumption of less than half of 5 lb. coal per horse per hour. Yet it may be shown that, so far as theory is concerned, there is no absurdity about the argument; and it may also be shown, we think, that no insuperable difficulties stand in the way of carrying theory into practice in this case. It is well understood now that there is no source of loss of efficiency which can compare in importance with cylinder condensation. If only steam could be maintained in cylinders as steam, and not as aqueous vapor or mist, or suspended or deposited water, then the highest degree of economy which theory points out as possible of attainment with any ratio of expansion might in practice be attained. To guard against condensation, cylinders are carefully clothed and jacketed; but even in the most economical engines which it is possible to construct, it is indisputable that a large percentage of the steam admitted to the cylinder is condensed, the condensation having nothing, to do with that due to the performance of work. In dealing with this fact we are prepared to admit, that it is impossible for any one to say with precision how much steam is wasted in this way; we have, however, data before us derived from elaborate experiments made with an engine having a 50 in. cylinder and a stroke of 8 ft. 9 in., in which the condensation amounted, when the stream was cut off at one-fourth of the stroke, to 46.5 per cent.; when the steam was cut off at one-third the loss fell to 28.7 per cent.; when cut off at half-stroke the loss was 25 per cent.; and when the cut-off took place at 58 per cent. of the stroke the loss was 18.74 per cent. The engine used at the last-named point of cut-off 32 lb. of steam per indicated horse-power per hour; so that the loss by cylinder condensation amounted to over 6 lb. per horse-power per hour under the most favorable conditions. The cylinder was well clothed but unjacketed, and the total initial pressure of the steam was 40.6 lb.

We could cite other examples taken from various experiments, if it were necessary, all tending to prove the proposition which we are about to put forward—namely, that under most favorable conditions the loss of steam due to cylinder condensation amounts to somewhere between 4 lb. and 6 lb. per horse per hour.

We shall not, we think, under the circumstances, err much if we assume that 5 lb. of steam per horse per hour are lost through cylinder condensation alone in high class engines working with saturated steam, and this without regard to the condensation due to the performance of work, but including all steam condensed in jackets. Now it is a very good engine indeed that can manage to get an indicated horse power per hour out of 20 lb. of steam. Of this, 5 lb. are wasted by cylinder condensation in nine cases out of ten. It follows that we burn 20 lb. of coal instead of 15 lb., and that the rate of consumption per horse power per hour is 33 per cent. higher than it might be if cylinder condensation were totally prevented. If we take the 33 per cent. as a factor, and argue that if the best compound engine working with 75 lb. steam wastes 33 per cent. of fuel, we have a margin available to cover losses from any other source in an engine working under different conditions, but in which cylinder condensation does not take place. In other words, if we have two engines, one working steam expansively under given conditions and the other not—the latter, however, not suffering from cylinder condensation—then, unless the gain due to expansion represents a greater gain than 33 per cent. on the working of the non-expansive engine, the latter may prove the more economical of the two. To put this numerically, if the expansive engine uses 20 lb. steam per horse-power per hour, of which 5 lb. are wasted by condensation, then a non-expansive engine using any quantity less than 20 lb. of which none is wasted, will compare favorably with it. We may, so to speak, set the advantage won by averting cylinder condensation against the gain which results from working high-pressure steam very expansively. To make this point perfectly clear, let us suppose that we have a cylinder fitted with a piston having an area of precisely one square foot. Then, if we admit one-eighth part of a cubic foot of steam of 75 lb. total pressure below the piston we can lift a weight of 4147 lb., omitting fractions, through a height of one foot.

As used under these conditions, a cubic foot of steam will lift 33,176 lb. a foot high; but we shall assume here for convenience that 60 cubic feet of 75 lb. steam expanded eightfold will develop in round numbers on horse-power. The 60 cubic feet of steam will weigh 10.74 lb. It is well known that it is impossible to get a horse-power in practice out of 10.74 lb. of steam. As we have said, the quantity required in practice cannot be much less than 20 lb. In a very accurate series of experiments carried out with a pair of compound pumping engines at Chatham Dockyard in 1874, the consumption of steam reached 18.92 lb.

In one set of experiments with the American steamer Rush, with compound engines it amounted to 18.38 lb.; in another experiment to 22.09 lb. If it were necessary we could go on adding example after example to prove that to get a horse-power out of 20 lb. of steam is an exceptionally excellent duty. We shall not attempt to prove here once more that an eightfold expansion of 75 lb. steam gives about the best possible results. We have the difference between 10.74 lb. and 20 lb. to account for, and the sources of loss may be classed under two heads—loss due to wasteful cylinder condensation 5 lb.; loss due to clearance, leakage, steam required to overcome back pressure, &c., 4.26 lb. We are perfectly aware that the loss by cylinder condensation *may*, under certain conditions, with very carefully jacketed cylinders, be as small, perhaps, as 2 lb. per horse per hour. In such instances, however, the engines are probably working with less than 20 lb. of steam per horse per hour. Thus in the case of the Rush, when using 18.38 lb. of steam per horse-power, 93 per cent. of the water was accounted for by the indicator. The loss by condensation was thus but 7 per cent., or little over 1½ lb. per horse-power per hour; but when the engines were using 22 lb. the loss reached nearly 25 per cent., or over 5 lb. per horse per hour. It would be but waste of time to adduce further arguments to prove that when an engine is using 20 lb. of steam per horse per hour, one-fourth of the steam is simply wasted in keeping the cylinder hot.

Let us now compare the case we have stated with the conditions which obtain when an engine is working at a disadvantage as regards the pressure and measure of expansion used, but at an advantage in that no condensation takes place in the cylinder. Steam with a pressure of 25 lb. is admitted to a cylinder having an area of a fraction over 1.65 of a foot, and is cut off at one-third stroke. The average pressure will be 17·5 lb., and the work done in lifting the piston 1 ft. will be, as in the first case, 4147 foot-pounds, but the volume of steam used instead of being one-eighth of a cubic foot, will be 55 of a cubic foot, and to produce a horse-power we shall have to pass 264 cubic feet of steam, weighing 16.73 lb., per hour through the cylinder. Now on the hypothesis that no condensation takes place, in this case, in the cylinder, and that the remaining losses will be the same in both engines, we have to add to 16.73 lb. only 4.26 lb., making the total 20.99 lb.—say 21 lb. From this it appears that if cylinder condensation could be wholly averted, a low-pressure engine working with a very moderate grade of expansion would be within 5 per cent. as economical as a high-pressure engine of the best type now in use.

Of course we shall be met at this point by the objection that if cylinder condensation can be avoided in one case it can be avoided in the other, and that the high-pressure engine will still, under the new conditions, be the better of the two; but a little examination of facts will overset this theory. In practice it is found to be impossible to avert cylinder condensation by any known expedient but one. Instead of using dry saturated steam we must use steam gas, or, in other words, superheated steam. But superheated high-pressure steam cannot be used in practice for reasons which are well understood by engineers; and the question has yet to be solved whether it is or is not possible to use it with low-pressure engines. All our arguments are based on the assumption that it is possible, and we shall endeavor in another article to demonstrate this prominently. In the mean time, however, it is expedient to notice the late Professor Rankine's investigation of the properties of steam gas. It will be seen that we claim for it the power of reducing the consumption of steam by about 25 per cent., or from 20 lb. per hour to about 15 lb. Now, Rankine's investigations go to show that when superheated steam is expanded without gain or loss of heat—a condition which may be said to be approximately attained when it is used in an unjacketed but well protected cylinder—the gain under favorable conditions is but 15 per cent.

On the other hand, however, he has also shown that when superheated steam is used at a constant temperature, the saving may amount to as much as 27 per cent. It would be impossible at the end of an article like this to deal with the questions which have to be considered in discussing the possibility of using low-pressure steam gas. All that we have endeavored to do, so far, is to prove that if cylinder condensation be averted, low-pressure steam will give as economical results as high-pressure steam. It is not necessary to prove that cylinder condensation cannot be averted by any other expedient but superheating. All experience goes to show that high-pressure highly-superheated steam cannot be used. It is very confidently asserted that low-pressure highly-superheated steam cannot be used satisfactorily. This last is the question which we wish to see re-opened. We have endeavored to prove that great advantages would be gained in the matter of economy if it can be used. It remains for us to adduce such arguments as we may to prove that superheated low-pressure steam may be used successfully and economically.

The Channel Tunnel.

The geological features of this project having now been duly considered, it remains to give some particulars of the engineering nature of the work. The distance across the Channel at the point selected is about 22 miles, but as considerable approaches will be necessary on either shore, in order to reach the level of the tunnel entrance, the entire scheme will embrace about 31 miles of railway. In the first instance shafts will be sunk on each shore to the depth of 450 feet below high-water mark, and, from the bottom of these, driftways will be driven for the drainage of the works whilst in progress, and for its permanent drainage after completion. The tunnel, which will be very similar to an ordinary railway tunnel having two lines of rails, will commence 200 feet above this driftway, and will be driven at an inclination of one foot in 80 to the junction with the drainage driftway, and then at a gradient of one to 2,940 to the centre of the Straits, where the tunnel from the English shore will meet that driven exactly in the same manner from the French shore, and, being united with it, will complete he submarine railway under the Channel. The drainage will be from the centre of the tunnel to either end.

In the execution of this work a driftway, 9 feet in diameter, will first be carried right trough, and this will afterwards be enlarged to the full size of the tun-

tnel. The problem of the execution of the tunnel in a reasonable time has been simplified by the invention of tunneling machinery, and the machine of Mr. Dickenson Baunton, which has been tried on a practical scale by the company in the lower or gray chalk, has been quite successful. The machine works like an auger boring a hole in wood. The chalk is cut off in slices, which break up and fall upon an endless band, which loads them into wagons behind the machine. The apparatus was tried by the Company at Messrs. Lee's Cement Works, Snodland, near Rochester, in the gray or lower bed of chalk, such as underlies the Channel. It made a driftway of 7 feet diameter, and it advanced at the rate of from a yard to a yard and a quarter per hour. At this rate it would only require two years to drive a driftway of 7 or 9 feet diameter from one side of the Channel to the other, a machine being started from each side. The cost of driving a heading would consist—1st, of tunneling machines, pumps, and pumping engines; 2nd, the hand labor, which would not be considerable, as the machine requires but few hands to work it; and, 3rd, interests on the capital expanded during the execution of this work, which might last two years or more Taking these three elements of expenditure into consideration and according to the calculation of experienced contractoas, it has been found that the driftway could be executed for £800,000, if it required only two years to make it.

As soon as the driftway was completed the success of the undertaking woulb be assured. It would furnish the necessary data for an exact estimation of the cost of the whole work and the time necessary for its execution. In fact, all that would be necessary would be to enlarge the driftway to the dimensions of an ordinary railway tunnel. It has been estimated by some engineers and contractors of considerable experience that after the drift-way was finished, four years' time and four millions of money would complete the work, including the junctions with the English and French railways on either shore. Sir John Hawkshaw and the engineers associated with him, however, think it prudent to double this estimate both of time and of cost, ot least until the preliminary work shall have given them the necessary datu for a more exact estimate of the duration and cost of the work.

Preliminary steps to test the practicability of the project are about to be put in hand without further delay, for which purpose an English and a French Company have been promoted to carry out experimental works on either side of the Channel. An Act has been passed by the British Parliament during the past Session to enable the English Company to acquire the necessary lands at St. Margaret's Bay, and it is understood that a *projet du loi* has also been passed in the French Senate to confer the necessary powers on the French Company. The works to be undertaken by these companies consist of sinking two shafts—one on either coast—about 150 yards deep, from which an ordinary mining drifting about half a mile long will be driven under the sea. This work would be a true beginning of the proposed permanent tunnel. Its cost is estimated at £160,000, of which sum it is understood the two companies will find £20,000 each; the Rothschild of London and Paris have each undertaken to find similar amounts; the Chemin de Fer du Nord will contribute £40,000, and the London, Chatham, and Dover and South Eastern Railways will respectively subscribe £20,000.

It may now be confidently anticipated that the commencement of this great work will not be delayed. In the foregoing account we have purposely refrained from entering into detail regarding means of ventilation and other minutiæ of construction. The progress of the work will, however, be closely watched. and we shall hope from time to time to give further particulars of its advancement in the chronicles of engineering in this journal.—*Van Nostrand's Magazine.*

On the Sinking of a Pair of Iron Shafts for an Experimental Amber Mine.

The supply of amber in commerce is mainly derived from the district of Samland, near Konisberg, in Eastern Prussia, where it occurs in a deposit locally called "blue earth," in a brown coal formation of the Tertiary age. Until lately amber was got chiefly by dredging and by collecting the fragments thrown up during heavy gales on to the sea-coast, or by shallow, irregular diggings a short distance inland. Recent geological researches having proved the continuity of the amber-bearing beds, the Prussian government considered it desirable to start an experimental mine, to determine the conditions upon which concessions might be granted to private individuals, the right of working amber being one of the Crown privileges in Prussia.

The locality selected is at Nortyken, in Samland, where the amber-bearing bed has been found by boring to a depth of 110 feet. The section is as follows:

Hard blue earth, without amber...	2	Feet.
Blue earth, rich in amber.....	4.9	"
Barren earth, no amber.....	1	"

The level of the bed is 18.7 below the level of the Baltic. The overlying strata, 140 feet thick, consists of sands and clays belonging to the brown coal formation. The works planned for laying out the mine consist of two winding shafts, two bore-holes for pumping, and the necessary engines and boilers. As a large quantity of water was to be looked for in sinking, it was decided to bore the shafts and line them with wrought iron tubes. The depth of both shafts is about 147 feet, and the distance between them is 73.8 feet

The boring head was a horizontal bar, carrying four chisels for cutting into the bottom of the hole, and two at each end radially for describing the outer curve of the shafts. It weighed about 17 cwt. The boring rods of wrought-iron were of two sizes, one being an inch square. used in boring percussively; and the other two inches square, used when a twisting af.ain was applied.

The sand pumps or shells, for removing the detritus produced in the boring, were of two sizes; the larger being 3.1 feet, and the smaller 2.1 feet in diameter, the length in each case being 6.4 feet. They were wrought iron cylinders with clack valves at the bottom, but the suspension was so arranged that when brought full to the surface they could be emptied by being tipped like a bucket, without the necessity of being detached from the rods. The iron tubes lining the shafts are of the best boiler plate, 0.8 inch thick, and 4.6 feet internal diameter, in lengths of 4 feet joined by internal rings of the same thickness and riveted. The tube is further strengthened internally by three longitudinal strips of iron of the same thickness. The bottom length of tube is of double thickness, and terminates in a cutting shoe of triangular section. The total weights of the lining tubes are 14 tons for shaft No. 1, and 45.6 tons for shaft No. 2, or rather more than one ton per lineal yard.

The sinking of the tubes was effected by pressure applied by screws. A cast-iron ring grooved underneath to fit the tube, and having four perforated lugs through which the pressure screws passed, was placed on the top of the tube, and the pressure was applied to the nuts by men working spanners. The lower ends of the screws were attached to a fixed point or abutment formed by a timber platform loaded with cast-iron; four screws were placed at equal distances around the circumference of the tube. The spanners were slung by tackles for convenience of manipulation, and four to five men worked at each, so that from 16 to 20 men were employed in pressing down the cylinder. The amount of material displaced for each length of tube was about 53 cubic feet, which was removed in four or five fillings of the larger sized shell in about six working hours. The sinking of the tube occupied about four hours, so that one complete length of the shaft tube was sunk, and a fresh length slung and adjusted for riveting in each shift of 12 hours. From the sandy nature of the ground little actual boring was required, the use of the chisels being confined to cutting through beds of shale. The work was done in day and night shifts of 12 hours, with an average of 27 men. No. 1 shaft was completed in 121 shifts, and No. 2 in 106 shifts, including both boring and riveting. The latter operation occupied rather more than half the time. The total cost of the two shafts was as follows:

Wrought-iron lining tubes.....	£5000
Boring Plant.....	1259
Carriage.....	720
Labor for riveting and sinking.....	715
Total.....	£6787

The water level during the sinking was constant at 32.8 feet below the surface, the shaft being about 48 feet above the bottom of the valley.—*Van Nostrand's Magazine.*

Novelties in Gas Manufacture.

Under the above head, *Iron* of March 25th gives the following:

"We now come to a more recent invention, which is being developed in England under the patents of Messrs. Kidd and Barff. In this instance we seem to advance a stage further than in the case of the Lowe process and the invention of Mr. Isham Baggs. According to this new method a fire is kindled in a sort of iron drum or upright cylinder, the burning material consisting of some kind of carbon. Charred peat is an excellent material, and powdered anthracite is said to answer, as also coke and breeze. Round the inside of the cylinder is a system of tubes, fed with water from an elevated cistern. The heat of the incandescent carbon generates steam in the tubes, the pressure corresponding to the height of the cistern above the latter. Through a small pipe steam is conducted down the side of the cylinder, and issues as a jet into the mouth of a larger pipe projecting from the side of the ashpit. By a well known law the jet of steam creates a draught of air which passes with it into the ashpit, whence the air and the steam ascend together through the furnace. A powerful draught is thus created, and at the same time an important chemical change is effected. The steam, the air, and the fuel are all decomposed, and fresh combinations take place. The oxygen of the steam and the air, uniting with the carbon of the fuel, goes to form a certain proportion of carbonic oxide and a much smaller proportion of carbonic acid. Hydrogen is liberated from the steam, and a large quantity of nitrogen comes from the air. The nitrogen does neither good nor harm, except that it adds to the bulk, which of course is undesirable. The carbonic acid would be extracted if the gas were to be burned for illuminating purposes, and might be greatly reduced in quantity at the outset if the pile of fuel were somewhat deeper. But the carbonic oxide and the hydrogen are abundant, and are of course peculiarly valuable for the production of heat. During the working of the apparatus, according as the carbon is carried off, so fresh fuel is sent in from the top through sliding covers worked by levers. The gases produced are combined as one permanent gas, and pass off from the generator through a pipe inserted in the side near the top. A sample of the gas thus produced from charred peat has been analysed by Mr. Keates, with the following result, in parts per hundred: Carbonic oxide, 28·5; hydrogen, 14·5; nitrogen, 53; carbonic acid, 4. Such gas is entirely free from noxious sulphur compounds, and Mr. Keates states that if it were used as a basis for illuminating gas, it would require no purification beyond that necessary for the removal of the carbonic acid. In a further report, Mr. Keates gives a calculation showing that one ton of carbon by this process would yield nearly 100,000 cubic feet of combustible gas. Adding the nitrogen, there would be a total of more than 200,000 cubic feet of gas, such as that to which the foregoing analysis refers. As charred peat, or wood charcoal, consists almost entirely of carbon, it is reckoned that one ton of such material treated by Mr. Kidd's method will yield 200,000 cubic feet of heating gas. Notwithstanding the diluting effect of the nitrogen, direct experiment shows that the heating power of the gas is very high.

"Reckoning the cost of the charred peat at £2.10s. per ton, the cost of the heating gas is, so far, 3d. per

1000 feet. The water costs but little, and the air nothing at all. The labor is comparatively trifling, as the furnace requires no more attention than an ordinary kitchen fire. The action is continuous, there being no drawing of charges and recharging of retorts, as in ordinary gas-making. The residual products are *nil*, except a trifling quantity of ash. All the carbon goes off in the gas, and is thus directly available for use. By the ordinary method of gas making, the greater portion of the carbon remains in the coke, and only about 13 per cent. of the heat-giving power of the coal goes into the gas. As even this small proportion of heat is burned to advantage in the existing gas stoves, there is reason to expect that the much larger portion contained in the gas manufactured as now described will render the latter peculiarly valuable. The purity of this heating gas is one of its great recommendations. It burns without emitting the slightest odor, and the products of its combustion be ing simply carbonic acid and water, they exercise no deleterious effect on silver or gilding, not the slightest degree of tarnishing being apparent. On entering a small building where the gas was being produced, and where the appliances were shown without any precantion, we could not perceive the slightest odor, nor was there any smoke or vapor to indicate that gas was being manufactured. We were conscious of nothing special, except that as the gas was being consumed there was a very considerable degree of heat. The contrast between the diminutive steam jet and the great rushing flame of burning gas was very remarkable.

"A distinguishing feature between this and the Lowe process consists in the simultaneous admission of steam and air. In the Lowe apparatus the operation is intermittent. The beauty of the Kidd and Barff contrivance consists partly in this—that whereas the decomposition of steam causes a large amount of heat to become latent, whereby there is a rapid tendency to lower the heat of the furnace, the constant rush of air provides a supply of oxygen which maintains the temperature. Both processes have this distinctive feature as compared with ordinary gas-making that whereas in the latter instance there is an external application of heat, and the furnace itself furnishes no gas, the other processes have no external source of heat, but the gas is generated in the furnace itself, which is central and enclosed. As already observed, ordinary gas-making fails to utilise the whole of the carbon, whereas these patent methods take up all the carbon to the last particle. So perfect is the action of the blast in the Kidd method that it is not an unusual thing on opening the ash-box to find it empty, the whole of the ash having gone off with the gas."

Gas-Light Intelligence.

United States.

The charge brought against the Bridgeport, Conn., Gas-Light Co, by Mayor Barnum of having defrauded the city of over $6.000, by furnishing each street lamp but four feet of gas per hour, where five feet was charged for, has been investigated by a Committee of the Common Council and ascertained to be without foundation. The burners were tested by the State Inspector at the request of the committee, and found to be of full capacity under the companies pressure. The committee, by a unanimous report entirely exonerated the gas company from any wrong action in the pemises, but state that the charge was made in good faith, owing to want of proper knowledge on the part of the chairman the Lamp Committee about the street pressure.

A New Strike of Gas.—A very large gas well has been struck in Clinton township, Butler county. Indications of oil induced the location of a well, and some days ago it pierced a gas rock or shale and the flow of gas has been so powerful that it has been almost impossible to control it. The well is fifteen miles nearer Pittsburg than the great wells in Donegal township, to which the new company is about to lay pipe. The Butler *Citizen* of the 30th ult. says: "The striking of this great gas well proves that there is a great gas belt extending from the southwest corner of Donegal township, through Clearfield, Summit, Jefferson and Clinton townships, and how far into Allegheny county we don't know. But we do know that this unlimited supply of gas cannot be consumed by the present generation, and with this tremendous fuel advantage Pittsburg should awake from its slough of despondency, rouse itself like a lion from its lair, and establish itself as the chief and ruling iron market of these United States.—*Amer. Manufacturer and Iron World.*

A Gas Committee's Report.—The special committee on the relations of the Gas Company to the city, reported as follows:

"We the undersigned select committee, appointed to consider the relations existing between the city and the Cincinnati Gas-Light and Coke Company, have the honor to state that they have thoroughly examined the subject in its various bearings, and report as follows,

"That there is a valid contract existing between the said Gas Company, and the city, which fixes the price of gas to the public lamps at two-thirds the average price at which gas shall or may be furnished to private individuals, in the cities of New Orleans, Baltimore, New York, Louisville, and Pittsburg.

"That the bills presented are in accordance therewith, are correct in every particular, and supported by vouchers, received monthly, from the various companies in each of the cities named.

"That the gas furnished by said company is testpe every half hour, day and night, and by the Deputy State Gas Inspector daily

"That the quality is fully 25 per cent. above the required standard.

"That the price charged for erecting posts, furnishing all the pipe, labor, material, connections, business, etc., is a fair and reasonable one, and as low as the same services could be rendered by any other party.

"That the contract for lighting, extinguishing, cleaning, and repairing, dates from July 1, 1866, and the charge therefor only exceeds by a few cents the actual expense pertaining thereto.

"Under these circumstances we are fully satisfied of the disposition of the Gas Company to deal fairly with the city, and therefore report adversely to incurring any expense in procuring experimental apparatus for the use of the city, more particularly as under the present law the State Gas Inspector is, without expense, required to furnish any required information in reference to gas whenever called upon so to do by the City Council or the Mayor of the city'

"Respectfully submitted,
"G. W. Roesche,
"A. Birnbryer,
"John Connolly."

—*Cin. Gazette.*

Great Britain.

Apparatus for Storage and Supply of Gas.—W. T. Sugg, has patented in Great Britain an apparatus for the storage and supply of gas. The improvements relate to the construction of gasholders suitable for railway, tramway, and like carriages. The invention consists in making the principle part of the gasholder of wood, and in shape and action like an accordeon bellows, but the present improvements lie in the making of the joints of leather and unvulcanized sheet rubber attached to one end by a solution of india rubber. The hose consists in wrapping a spiral coil of wire with leather and india rubber, and a small flexible tubing is precisely similar in make.

Pumping Engine for the Water Works at Hull, England.—A new Cornish pumping engine was started at this place on the 28th of December, 1875. This engine is one of the largest of the kind yet constructed, having a 90-in. cylinder, with a stroke of 11 feet, and presents, especially in the pumping arrangements, several peculiarities. The *Engineer* (London) promises illustrations of the machine at an early impression, merely making the chronicle of the start with the statement that it was in every respect successful.—*Jour. Franklin Institute.*

Chemical and Scientific Repertory.

Production of Silk in France.—The gross weight of cocoons for 1873 was 9,883,580 kilos., valued at 68,614,802 francs. Of this amount 94 per cent was furnished by the eight southern departments of Le Gard, la Drome, l'Ardeche, Vaucluse, Bouches du Rhone, Isère, and Hérault. In twenty-five other departments production is insignificant, and in fifty-four others it is unknown. In 1874 the yield did not differ much from that of 1873.—*Les Mondes.*

Asphalt Pavement in England.—Much dissatisfaction has arisen from the use of this pavement in the crowded thoroughfares of London. The constant falling of horses and of men upon the surface, made slippery by the thin layer of slime which the damp climate produces from street offal, has reached a point beyond the endurance of the English public. It is proposed to substitute wood pavement.—*Journal of Franklin Institute.*

A Forgotten Color.—The simple decoction of onion-peel is said to produce upon glove-leather an orange-yellow superior in lustre to any other. It is also said to be suitable for mixing with light bark shades, especially willow bark, and as a yellow for modulating browns. The onion-dye is said to fix itself readily, even upon leathers which resist colors, and covers them well and even. Dr. Reimann seems, however, almost as sceptical of the tinctorial powers of onions as of truffles.—*Chemical News.*

Accidents from "Non-Explosive" Oils.—We have lately noticed with satisfaction the record of a decision by the Supreme Court of Louisiana, affirming liability of advertisers of "non-explosive" oils for damages, in the event of accident or injury resulting from their use. The petroleum inspection laws of this State, which, if properly enforced, might afford a very reasonable degree of security to the users of burning oils, have proved in practice (which introduces the personel equation) so utterly inefficient as to be generally admitted to be worthless. Perhaps the prosecution of unscrupulous compounders of benzine mixtures and "combinations" may lead to something more tangible in the way of protecting life and property.—*Polytechnic Review.*

Poisoning by Carbolic Acid—Recovery.—A case is reported in the *Medical Times and Gazette* of a woman in Liverpool, forty years of age, who had swallowed nearly a teacupful of crude carbolic acid. She was seen by Mr. E. S. Wood about twenty minutes after she had taken the dose. He immediately used the stomach pump, and washed out the stomach several times with tepid water. He then injected a pint of olive oil into the stomach, and applied mustard poultices to the legs and the precordial region. She was removed to the Northern Hospital, and after about a month's treatment with milk, barley water, lime water and ice, she ultimately recovered.

A Good Whitewash.—The following recipe for whitewash is recommended by the Treasury Department to all lighthouse keepers. It answers for wood, brick, or stone. Slake about half a bushel unslaked lime with boiling water, keeping it covered during the process. Strain it, and add a peck of salt, dissolved in warm water, three pounds of ground rice put in boiling water and boiled to a thin paste, half a pound powdered Spanish whiting, and one pound clear glue dissolved in warm water; mix these well together and let the mixture stand for several days. Keep the wash thus prepared in a kettle or portable furnace, and when used put it on as hot as possible, with either painters' or whitewash brushes.

A "Certain" Cure for Rheumatism.—Judging from his article in the *Wiener Medizinische Presse* Dr. Franz Heller is an enthusiast in the administratio

of caustic ammonia in rheumatism. For several years he had been a sufferer from severe muscular rheumatism in the right shoulder; he had taken all the common anti-rheumatic remedies with but little alleviation, when he began to reason that in rheumatism, as in gout, there may be a uric acid diathesis; he thought that liquor ammoniæ, on account of its rapid volatilization, would be the remedy most readily absorbed, and the most prompt in action. In almost the same moment, in which he took one drop, diluted with water, he felt a complete relief from the pain which had lasted for ten hours; he was now able to move freely the arm which, an instant before, he could scarcely bear to have touched. The remedy, he claims, has proved a positive cure in all recent cases of muscular rheumatism which have fallen under his observation; he cites numerous cases in which relief, as instantaneous as his own, was experienced.

He also observed its effects in several cases of acute articular rheumatism, in two of which six drops sufficed to subdue the pain and swelling within a period of twenty-four hours.

In one case of chronic rheumatism of a finger joint, which had lasted for over half a year, the simple administration of the ammonia completely dispelled the inflammation and pain in the joint within two days.

He then dicusses the mode of action of his remedy. "If we consider an excessive acidity as the cause of the rheumatism, we can scarcely claim in the cases in which one drop will instantaneously relieve the pain in recent rheumatism, that one drop was sufficient to counteract the effects of the excess of uric or (according to Fuller) lactic acid.

"Nothing remains therefore but for us to seek for the source of rheumatism in a morbid nervous activity induced by disturbances of nutrition, and to believe that the ammonia acts as a nervine directly upon the nerves."—*New Remedies.*

The Soda-Lakes of Wyoming.—An acccount of the soda-lakes of Wyoming Territory is given in the report of Mr. Pontez, geologist of the Union Pacific Railroad. He describes two such lakes, the larger one covering about 200 acres. The average depth of water in this lake is three feet, and its specific gravity 1.097. The soda is nearly all carbonate. The second lake is situated near the first, and covers about 3½ acres. During the greater part of the year it is a concrete mass of carbonate-of-soda crystals. Mr. Pontez excavated to the depth of six feet without reaching the bottom of the deposit, which is constantly increasing from the influx from the larger lake. These lakes are situated about 65 miles from Rawlins Station, on the Union Pacific Railroad. The quality of the carbonate is declared to be fully equal to the imported article. Estimating the quantity by the specific gravity of the water, its depth and area, the large lake would yield on evaporation 78,000 tons, which would realize, at $45 per ton, $4,510,000. Besides the cost of freight, the expense of preparing the article for market would be $4 per ton for evaporating. The small lake already crystallized, and estimated only at a depth of six feet and an area of 155,000 feet, contains 30,660 tons, which at $45 per ton would realize $1,379,700.—*Popular Science Monthly.*

Resonant Alloys.—A patent has recently been granted to Professor Silliman, of New Haven, for a process of imparting resonance to Brittannia, pewter, white metal, and other alloys, which ordinarily give, when struck, only a dull leaden sound. The process consists in submitting articles formed of these alloys to the action of a regulated and well-determined temperature, just short of their melting point, for a briej but measured time. This is done in a bath of oil or paraffine, care being taken to avoid contact of water or even of a damp surface, which might cause a steam explosion, scattering the bath. All contact of the articles with metallic tools while in the bath must also be avoided. If a rod of less fusible metal touches the alloy under such circumstances it cuts it like a soldering iron. The theory of the process appears to turn upon a rearrangement, perhaps a crystallization, of the molecular particles.—*Iron.*

To Make gold and Silver Inks.—By H. C. Viedt.—Good bright gold, silver and bronze inks are seldom met in the market; they are almost always of a dull color, do not flow easily from the pen, and the writing remains sticky. Hence, architects and artists mostly prefer to use shell gold and shell silver (*Muschel silber*), instead of the corresponding ink. The latter, however, is so much easier and safer to use, that I will describe its preparation.

For gold ink, it is best to employ genuine gold leaf, but owing to the expense, this is seldom used; sometimes mosaic fold (sulphide of tin) or iodide of lead is employed, but almost always Dutch leaf.

Owing to the relatively low price of silver, genuine silver foil is used for silver ink; false silver foil is seldom used, and is not so good. For other metallic inks, commercial bronze powders are employed. The genuine and false foils are also sold in a finely pulverized state; they are made from the waste of the goldbeaters, by rubbing it, in metallic sieves, to an impalpable powder.

In consequence of the beating between goldbeaters' skin, it has particles of grease and other impurities attached to it which must be removed before it can be used for ink. For this purpose the whole sheets, or the commercial bronze powder, are triturated with a little honey to a thin magma on a glass or porphyry plate with a pestle, as carefully as possible, as the beauty of the ink depends essentially on this. The finely rubbed paste is rinsed into a thin glass beaker, boiled for a long time with water containing a little alkali, frequently stirred, decanted, well washed with hot water, and dried at a gentle heat. By boiling this powder with water containing sulphuric, nitric, or hydrochloric acid, different shades can be imparted to it.

Next, a solution of 1 part of white gum arabic in 4 parts of distilled water is mixed with one part of potash water glass, and triturated with the requisite quantity of purified metallic powder. Gold ink will bear more liquid than silver ink, since gold covers much better; on rough paper more metal is necessary than on sized paper; on light paper more than on dark, to make the color of the ink appear equally intense.

In general, 1 part of foil is enough for 3 or 4 parts of the above liquid. In preparing large quantities of ink, a low porcelain measure is used for transferring it to the small glass vessels where it is to be kept, and it must be continually and thoroughly stirred, so that it will always keep well mixed. It requires frequent stirring also when in use. It is best to mix the dry powder with the liquid immediately before using. The ink can be used with a common steel pen, and flows very well when writing slowly, but it is better to use a pencil.

I consider the use of potash water glass of great importance. It greatly increases the metallic lustre on paper, prevents its looking dead, protects the writing from being discolored by the action of the atmosphere, and also prevents it from penetrating too far into the pores of the paper, without rendering it very viscid. Although the writing of itself possesses a high metallic lustre, it may be increased by gently polishing with a polishing steel. Inks made with mosaic gold, mosaic silver, iodide of lead, etc., are not nearly so beautiful.—*The American Chemist.*

Ferry-Boat Ventilation.—The patrons of the greatest thoroughfare in the world—the ferry between New York and Brooklyn—are to be congratulated on the adoption of means of ventilation. The plan is admirable alike for its simplicity and efficiency, and the wonder is that it has been so long delayed. It consists of a self-acting exhaust current by means of a box over each cabin with swinging doors at the ends; the motion of the boat either way serves to close the forward door and so prevent a draught, while by the same motion of the boat the foul air in the cabins is given a counter current, and rising, forces open the rear door and escapes. The same arrangement is equally applicable to the city railroad cars, and should be required by the health authorities.—*Sanitarian.*

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—Ed.

[The following letter has been furnished us by a friend, who obtained permission of the writer to publish it.—Ed.]

Wood Gas.

Des Moines, Iowa, March 12, 1876.

Dear Sir: Your esteemed favor of the 6th inst. was forwarded from La Porte, and came to hand last evening. I cannot hope to answer all your inquiries satisfactorily, but you shall have the benefit of whatever of *light* there is in me.

1st. We have been supplying La Porte with gas made entirely from wood and petroleum, for three months past.

2nd. We use all kinds of wood, but prefer maple and beach.

3rd. We can get 26,000 feet of gas from one cord of maple wood, and about 29,000 from one cord of beach, without any *enricher*.

4th. There is so little illuminating power in gas made from non-resinous woods without enriching, that I have never tried to measure it. Gas made from pine or other *similar* resinous wood, will have an illuminating power equal to about 13 candles.

5th. We enrich with crude petroleum, but from experiments I have made, I should be inclined to favor *crude* naphtha as an enricher. We can make 1000 cubic feet of 18 candle gas from 100 lbs. of wood, and four gallons of petroleum. We are using a bench of threes. The two lower retorts are used exclusively for wood, and the upper one for distilling the oil and uniting the two gases. The gas from the wood is passed through the upper retort, where it not only mixes with the oil gas, but assists the distillation, and both pass off together through the stand-pipe from the upper retort.

6th. We have used wood that was seasoned in the ordinary way, and was not very dry. It should be thoroughly seasoned, otherwise it is difficult to keep up heats.

7th. We use the same process for purifying that we use for coal gas, to wit, *lime*. So far we have used one bushel of unslacked lime to 40,000 feet of gas.

8th. Our meters are the same as we have been using for coal gas. They were made by the American Meter Company, and Harris, Griffin & Co.

9th. Cannot tell how long a meter will last; ours do not appear to be injured as yet.

10th. I have been unable to discover any pyroligneous acid in the gas. Am of the opinion that most of it, if not all, is deposited in the hydraulic main. We keep a small stream of water passing through the main all the time; besides, we clean it out every week.

11th. Our consumers appear satisfied, and frequently compliment the company for good gas. We had run the wood gas a month before our consumers knew it. We have been unable to discover any odor from the gas that we have made while burning, but I have noticed it from gas made by the same process in Chicago. The Tremont House of that city is lighted with gas made from wood and petroleum, in works built especially for it. They have but one purifier and that is very small. They have never cleaned their hydraulic main, nor in any way given attention to the question of purification, which I deem of great importance in this process.

12th. Our retorts are nine feet long (outside). They were made and set for coal. We can use the lower ones for coal now, or at any time, without any change whatever.

13th. We have been using ordinary four feet cord wood without any preparation whatever. We have also experimented with it in all conditions. We have cut it up into stove wood, split almost as fine as kind-

ling, but prefer medium size stick of split body wood. It makes gas too fast when cut up fine.

14th. We give it three hours.

15th. And charge 150 lbs.

16th. Our retorts show a bright orange color on the outside.

17th. One good man can work two benches.

18th. The charcoal will furnish about one-third the fuel, if consumed; but if sold at a fair price, would purchase coal for the entire work of heating. We burn the charcoal and use coke for the balance, because we have a quantity on hand. *Block* coal is the best fuel for heating an arch or oven that I have yet found. It makes a steady fire, needs but little attention, and does not clinker.

19th. The gas furnished to our consumers is 18 candle power.

20th. We sell to the city, for streets and offices, at $3.20, and to private consumers at $3.50 per 1000 cubic feet.

21st. Our consumers use the same burners used for coal gas; no change in burners or in pressure made necessary. Yours very truly,

J. F. Marsh.

Reply to Mr. Allen.

New York, April 10, 1876.

Mr. Editor: Mr. H. P. Allen, in your last issue, in an article frankly styled "Very Gassy," is so kind as to defend the managers of the Lowe process from a charge of "undue modesty." I hope he will take it good-naturedly, if I say that he ought to be first-rate counsel in such a cause. I am however compelled to correct some grave errors in his letter.

1st. We have *not* simulated the name of the National Coal Gas Co., by adopting a similar style in a circular. No circular has been issued, no stock company has been formed, as we have no shares to sell, regarding our business good enough to keep; though in consideration of Mr. Allen's long efforts on behalf of our methods, we will grant him a local license for Poughkeepsie, on exceptional terms.

2nd. The patent cupola, owned by his company, we agree with him as "worthless," and we could not possibly be induced to use anything approximating it in our system. Possibly he has forgotten that in September last, I distinctly stated, that if he or any one else supposed we were touching upon their rights (a thing we have never intended, and do not believe), we would listen most respectfully to an opinion of the Supreme Court.

3rd. Mr. Allen urges the superiority of the Gwynne-Harris method, because "if for any reason it does not prove satisfactory," works can be so readily transformed back to the old system. We had, in our good will toward all who are valorously demonstrating our methods, hoped that our neighbors at Poughkeepsie were meeting good success, and regret sincerely that "if" is still a quantity in their calculations. That word is happily cast out of our vocabulary, and justifies us in re-asserting, "that by no process to this present time known and demonstrated on a large working scale, has an illuminating gas of so fine a quality been produced, at anything like so low a cost, as by the Lowe process." Facts and figures on call.

About a dozen more lines please, in which to answer the column of complaint from Mr. Antes of Sedalia, Mo. As there are in the United States over eight hundred gas companies, and as their different fields of operation represent wide differences in cost of materials and labor, we have seen no better way of giving them a basis for estimating the comparative advantages of the Lowe process, than by simply and honestly stating the amount of labor required, and the quantities of coal, oil and lime, to produce one thousand feet of gas, leaving each one to figure cost, according to local circumstances and his own judgment.

We had even supposed there might exist some little delicacy on the part of their officers, about furnishing us with all the details of their business, and especially any items not properly or ordinarily charged to cost in holder.

If, however, Mr. Antes will forward to me the current prices for anthracite, petroleum, lime and labor at Sedalia, and will furnish also all the items he enumerates and some he has omitted, together with his daily production of gas, I will give him an immediate and exact calculation of total cost per thousand feet, including the royalty, and he can then compare the two systems at his leisure. It may be fair to add that there is a spectre walking hereabout, known as "kerosene" knocking at the companies doors and refusing to be quiet. It is possible that he may not have looked in on Sedalia. We believe that an effectual way of laying him is to put him through a Lowe super heater and so convert him into a friend.

Yours very truly,

George S. Dwight,

Complimentary.

Charlestown, Mass., April 7, 1876.

Mr. Editor; In the last number of the Journal, in referring to my report of the proceedings of the annual meeting of the New England Association of Gas Engineers, you made kindly and complimentary allusions to myself, which I duly appreciate, and for which please accept my thanks. I assure you, however, that the report would not have been so complete or satisfactory, had I not received valuable assistance from A. B. Slater, Esq., the efficient and courteous manager of the Providence Gas-Light Co., who, from his knowledge of phonography, was able to furnish me with a verbatim report of the greater part of the most important discussions, and of much of the proceedings in detail, which I could not otherwise have obtained.

As an amateur phonographer, who has learned the art, not for practical use as a profession, but rather from individual taste for the accomplishment, and for private purposes, I think Mr. Slater has been remarkably successful, and is entitled to much commendation for the patience and industry which he must have devoted to the acquisition of this useful but difficult art.

I desire for myself, and in behalf of the association, through your columns, to thank Mr. Slater for the valuable and gratuitous services rendered by him as above stated to myself, the association, and the gas fraternity at large. Respectfully yours,

George B. Neal,
Secretary of Association, etc.

The Childrens' Hospital *et al. vs.* Henry Bumm *et al.*

[This is an action in Equity, brought to compel the discontinuance of gas nuisance in Philadelphia. The following is a part of the affidavit of Mr. Robert Briggs, C. E.—Ed.]

The making of coal gas by distillation in retorts would be one of the simplest of the manufacturing operations if it were not accompanied with certain other products and involved with certain impurities which it becomes necessary to treat, or to remove, to render the process or its result tolerable to any community. To make the whole of this process intelligible I will state, as a brief of the operation:

§ I. Coal oil, for illuminating purposes, is produced from bituminous coal by destructive distillation. [Ordinary distillation, as of alcohol from wine, merely separates by evaporation at a lower temperature, one substance from another; destructive distillation alters chemically, by heat, the nature of the bodies exposed to the operation.] Bituminous coal itself is assumed to be a fossil of vegetable origin, which may have been charred by heat and solidified by pressure; and it consists of the following elementary substances:—first, and mainly, carbon; second, sulphur; third, silicium (with very small quantities of other earth metals); fourth, iron (rarely any other metals); fifth, hydrogen; sixth, oxygen; seventh, nitrogen (with very small proportions of other gaseous bodies). One ton (2240 pounds) of bituminous coal, of average quality, will produce about nine thousand to ten thousand cubic feet of gas, also of average quality. Gas of average quality is held to be such, that the burning, in a suitable burner, at the rate of five cubic feet per hour, will evolve an intensity of light equalling that which will proceed from fourteen to sixteen standard sperm candles, of six to the pound, each burning 120 grains per hour. This ton of coal will also yield, and pass off from the retorts with the gas, as vapor, about twelve to thirteen gallons of coal tar, and fifteen to seventeen gallons of ammoniacal liquor; and after the volatile portions have passed away from the retort almost completely, (that is, when the gas from the retorts ceases to possess the requisite illuminating power,) there remains in the retorts about 1700 pounds of spent coal, denominated gas coke.

The four products of coal, which are separated distinctly in the process of distillation, are (stating them in reverse order):—First, coke; second, coal-tar; third, ammoniacal liquor; fourth, crude gas. And each of these four products are treated severally.

[§ § *One.*] The coke which remains in the retorts, and is removed from them at a higher heat, consists principally of carbon (90 to 95 per cent.), while the remainder is the earth metals, and iron and oxygen, together with a little sulphur, perhaps, in combination with the iron. In quenching the coke, a copious steam is produced, which takes off and disperses within a few feet, not generally over 200 feet distant, a quantity of dust of the coke, in the form of coarse, perceptible grains, and a small quantity of sulphurous gas, while a smaller quantity of sulphuretted hydrogen, is dispersed in the atmosphere at the same time. The coke itself, after being cooled, takes up and absorbs most hydrocarbon vapors, carbonic acid and other gases, with much avidity. But little nuisance arises from coke, except when the steam and gas of quenching are dispersed at improper elevation, or too near to other property or to public thoroughfares

[§ § *Two.*] The coal tar which passes away from the retorts with other volatile bodies, is intimately mixed with them at the temperature at which they leave the retorts, but is mainly condensed in a pipe or closed vessel, denominated the hydraulic main; some of it, however, passes beyond the hydraulic main and is separated with much difficulty, in the condenser and washers (whose purpose is mainly to remove ammoniacal liquors). Small quantities of coal tar are always found in the pipes in the street, and if the parts of the apparatus are not properly arranged, the coal tar will be found in quantity in the purifiers, in the street pipes, and even in the house services. This coal tar consists almost entirely of an innumerable and a variable number of definite chemical compounds of carbon and hydrogen, together with those of carbon, hydrogen and oxygen. All these hydrocarbons intermingle with each other in all proportions, making inseparable mixtures at ordinary temperatures; and they also absorb the gaseous hydrocarbons with which they may be brought in contact, with rates which increase as the temperatures are reduced. A very small proportion of sulphur will be found in coal tar, being probably only that due to the absorption of sulphur-gaseous bodies in the crude gas. Crude coal tar, as it is collected from all sources about the gas-works, is a thin liquid at the general temperature of the atmosphere, having at the first moment of smelling of fresh coal tar, a pungent but not highly offensive odor; but the continued exposure of a considerable surface for evaporation to the air, or the presence of the least of the substance in dwellings or occupied rooms or upon clothing, develops a persistent and disagreeable smell, scarcely equalled by that fro many other material in the arts.

It is admitted by all physicians and chemists that the odors from coal tar vapors are (in the proportions in which they will diffuse in the air) not absolutely deleterious or poisonous, many of them being classed and used as disinfectants; but, on the other hand, the gas maker has fully recognized their objectionable character; and in all works, the coal-tar is collected

in sealed vessels, conveyed about the works in closed pipes, and deposited in closed pipes, and deposited in a closed tank or cistern, to be afterwards disposed of. The numerous substances mixed in coal tar separate by distillation at temperatures below the destructive one, into three classes—1, light oils; 2, dead oils; 3, pitch.

On boiling coal tar in a closed kettle up to about four hundred degrees, a mixture of various hydrocarbons will pass off like oils; these can be condensed by a coil of pipe in water, and will be found to be lighter than water; at higher temperatures, up to five hundred and fifty degrees, oils will distil over, which will be heavier than water, and are therefore called dead; after this process, there is left a pitch of numerous bituminous bodies not separated by chemists.

This pitch is used for roofing, sidewalks, and similar purposes; the oils are sold to make lamp-black and for the preparation of printers' ink. But the demand for coal tar or coal-tar products is small, and the price of the latter unremunerative, except to those who can use the products directly, and in some works the coal tar is burned under the retorts, while in many it is surreptitiously wasted or discharged into sewers or streams.

The light oils will be found to have in them, when condensed, most of the gases that may have been absorbed by the crude coal tar, and their rectification for lubricating oils is first accompanied by the escape of these gases, and after this is done the thin oil becomes not very unpleasantly odoriferous. The gases from this process should be burned, but their extreme levity will always occasion a rapid dissipation in the atmosphere. The he vy oils are less offensive; and the pitch has a characteristic odor not very permeating, or unpleasant to most persons when smelled in the open air, or outside of dwelling rooms.

[§ § *Three.*] The ammoniacal liquor, like the coal tar, is intimately mixed with the crude gas. A portion is condensed with the tar, but it mostly goes beyond the hydraulic main to the condenser, which is a large extent of pipe or plate surface exposed to the air or to water on the outside of pipes or boxes, and acting by cooling the hot gas; when the ammoniacal liquor in the gas condenses and runs down upon the inside, collecting and absorbing ammonia vapor, as the cooling proceeds. After passing the condenser, the gas flows through a washer, where, having become cool, it is brought in contact with streams of ammoniacal liquor or fresh water, which take up and remove nearly all the ammonium compounds; water having a very high absorption rate for them when cold, and parting with them readily when warm.

The ammoniacal liquor consists of water holding in solution various compounds of ammonium (NH_4) with carbon, sulphur and cyanogen (CN). The liquor also has absorbed definite quantities of sulphuretted hydrogen and of all other gases present. This ammoniacal liquor is exceedingly offensive and permeating. The hair and woolen clothes absorb the ammonium compounds with much avidity, and retain the odor for a great length of time. The objectionable nature of these odors is admitted by all, and every means is taken, in gas-works, to isolate and remove the ammoniacal liquor. Until recently (in this country) it was discharged into sewers and streams, where it aggravated inconceivably the condition of the sewage water and poisoned the stream; but in all well-managed works of to-day, the ammoniacal liquor is treated (or removed in pipes to other places for treatment) so as to yield a good return to the maker and avoid all nuisance, as the treatment can be carried on without the least exposure of the liquor to the air.

[§ § *Four.*] The crude gas, being freed from tar and ammoniacal liquor, is yet charged with certain impurities which should be removed before it can be distributed in the mains and burned in stores or dwellings. It consists of four parts: *a*, the burning substances; *b*, the luminous or incandescent ones; *c*, the impurities; *d*, certain non-burning substances. (*a.*) The burning substances are hydrogen; one of the compounds of hydrogen and carbon (marsh gas, CH_4); and carbonic oxide, or half burned carbon. (*b.*) The luminous or incandescent substances are numerous carbon compounds which may be substituted for each other, in any separate examples taken for analysis, but which do not exceed four per cent. of the gas for 14-candle illuminating power. (*c.*) The impurities to contend with are sulphuretted hydrogen, sulphur and ammonium components and naphthaline. (*d.*) The non burning substances are atmospheric air and carbonic acid.

The sulphur-compound impurities are the most objectionable to the consumer, as the immediate result from imperfect purification in this regard is a complaint by them. The legal requirement, in England, is that the gas shall be purified from sulphur compounds, until it will pass inspection at less than 20 grains weight of sulphur to 100 cubic feet.

Most of the sulphur distilled from the coal passes over with the ammoniacal liquor, and the authorities vary considerably as to the quantity present in crude gas. But, taking the weight of a cubic foot of crude gas, at the temperature of sixty degrees Fahrenheit, with the density of 14-candle gas, as equalling 230 grains, and two-tenths of one per cent. as the weight of sulphur, there would be four and six-tenths grains of sulphur per cubic foot, while the standard for excellence is (as has been stated, 20 grains per 100 ft.) two-tenth grains per cubic foot; showing that only one twenty-third the sulphur which existed in crude gas, is tolerated in purified gas. When gas, either crude or purified, is burned, all the compounds are reorganized in the products of combustion; the sulphur compounds are decomposed, the sulphur itself going to form with oxygen sulphurous acid: the ammonia compounds resolve into nitrogen and hydrogen, the latter going to form, with oxygen, water; but it is possible that a little nitric acid may form in the process of incomplete combustion. The sulphurous acid, also, probably transforms in the air into sulphuric acid. At all events, the effect of sulphur in gas, even when reduced to very small amounts, approximating in quantity to the standard accepted by English law, is very perceptible upon colors of fabrics, paints, leather, etc., and especially perceptible to the occupants of rooms in which many burners are used. A sensation, not so much of smell, but of dryness and acridity in the nostrils and throat, accompanied with a binding feeling in the forehead, is recognized as the indication of bad gas; and immediately complaint follows when imperfect purification has occurred.

In the history of the manufacture of gas, it appears that the earliest difficulty encountered was this defect of crude gas; and the necessity of removal of sulphur at once engaged the attention of the first gas-makers. These gas-makers were not chemists, and the science of chemistry had scarcely then, in 1800–10, reached the point to designate what was required to effect the purpose—it was consequently a mere trial of various substances.

Washing with water was first resorted to, and after a time lime-water was substituted in the hope that it might answer. The use of lime water proved very satisfactory, and up to the present time no material of cheap or ready application has been found so efficient and satisfactory in result, although it will be seen that it has some troubles in the disposition of the spent lime-water, in the gas-works themselves, that have so far proved insuperable.

The ammonium compounds, when present in the gas, are less harmful to the consumer, but they destroy the grease of the gas-cocks, injure the burner-tips, rust away and eat up the material of the gas-meters, occasion deposits of very offensive liquors which sometimes escape, and they impair materially the illuminating quality of the gas.

The naphthaline passes off with the gas from the retort as a vapor (probably other hydrocarbons of nearly the same constitution accompany what the gas maker knows as naphthaline). It is one of the few hydrocarbons which isolate themselves positively in the process of destructive distillation of coal, and at ordinary temperatures is seen as a fine white crystalline mass, in which form it condenses and deposits as the gas is cooled. Crude coal tar has a large quantity dissolved in its oils, which is separated by heat, between the light and heavy oils. It is believed, however, that crude coal tar will absorb it all (or nearly all) if the tar is allowed to remain, and be brought in contact with the gas until quite cold; but as the tar also absorbs all the gaseous illuminants in this way, this proces is not available. Naphthaline occasions stoppage of the pipes in cold weather, and is a source of great trouble to some gas-works, where the condensation is not slow enough to separate it. It is freely dissolved and absorbed by gaseous hydrocarbons (the luminant gases) and when it occurs in pipes can be removed by use of a very rich gas for a time. It is a luminant itself, and can only be classed with the impurities, because it must be removed to certain limits of quantity (varying with certain seasons of the year) to admit of the service and distribution of gas.

Naphthaline has a pungent, distinctive odor, which disseminates to great distances when any of the vapor is allowed to escape. It is probably the vehicle of other smells from coal gas, as musk is made to convey some perfumes. Naphthaline resembles camphor in many ways.

The non-burning substances are not injurious, only that their presence in any proportion reduces the luminous efficiency of gas, to a far greater extent than is due to the quantity present. A very little air or carbonic acid will reduce the light of a fourteen-candle burner to that of seven candles. One per cent. of carbonic acid is said to impair the light five per cent., and six per cent. of air to impair it fifty per cent. The air accompanying any gas, comes from changing the purifiers at the works, and similar admissions; but carbonic acid is one of the products of distillation.

Of all these compounds of the gas, but very few are positively poisonous. Sulphuretted hydrogen (mainly), and carbonic oxide (in a less degree), are the most abundant and dangerous by themselves. Some of the ammonium compounds would be equally noxious if they were isolated, and if sufficient quantities were dispersed in any locality; but, as before stated, complete combustion reduces all these products to comparative harmlessness.

In the burning of a gas flame, the burning substances appear to be employed in establishing such a heat as shall cause the particles of carbon in the luminants to become incandescent, and the light is assumed to proceed from these particles, which are intensely heated and isolated from oxygen (air), so that they do not burn at that instant; the further progress of combustion is the burning of these particles, so that they will be made into carbonic acid, and not be disseminated as smoke. If the heat is not intense enough they may never become incandescent or luminous, but merely separate fron their vehicle (the hydrocarbon), and pass off as smoke altogether.

These facts in the manufacture, process or chemistry of gas-making have been collected from various sources, no one writer or investigator having of himself the information here given. The most elaborate and exhaustive collection of data yet known to me, bearing directly on these points, will be found in a published lecture of Professor C. F. Chandler, delivered before the American Gas-Light Association, New York, October 20th, 1875.

§ II. Having followed the chemical and physical phenomena of the production of illuminating coal gas from bituminous coal, the apparatus and manipulation can next be exhibited; and the works of the Philadelphia Gas Trust, at Market street station, can well be taken as a type of practice.

I have visited these works, in company with others, for the purpose of observation and examination, and can describe with accuracy their construction and process of working.

The Market street station of the Philadelphia gas works is situated on the river Schuylkill, the works themselves being west of Twenty-fourth street, and between Chestnut and Market, and Market and Fil-

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

A. M. CALLENDER & CO.,
PROPRIETORS.

Editor—G. WARREN DRESSER.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH
At No. 42 Pine Street, New York.

This is a recognized official organ of—
LIGHT, HEAT, MINING INTERESTS, STEAM, WATER-SUPPLY, PATENTED INVENTIONS, VENTILATION, SANITARY IMPOVEMENT, AND GENERAL CHEMICAL SCIENCE.

TERMS

SUBSCRIPTION—Three Dollars per annum, in advance.

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PHILADELPHIA—COE, WETHERILL & Co., Ledger Buildings, Phila.
Germany—B. WESTERMANN & Co., of New York.

MONDAY, APRIL 17, 1876.

bert streets, where are located coal-houses, retort-houses, washer and condenser houses, purifying houses, lime-kilns and other similar buildings; and the station also includes a square between Market and Filbert and Twenty-third and Twenty-fourth streets, which square is occupied by holders, meter-houses, etc.

The commencement of the operation is in the retort-house.

[§ § *One.*] The retorts are receptacles for the coal in which it is enclosed to be heated. In the Philadelphia gas works retort-house, they are long vessels of clay, measuring nine feet internally in length, and having a ⌓ section of twenty inches in width and twelve inches in height. The clay is two and a half or three inches thick, and increased in thickness to four inches, in a band around the mouth end, the back end being closed. This kind of retort is generally used in America, the section of twelve inches by twenty inches is very common, but thirteen inches by twenty two inches, and even fifteen inches by twenty-four inches is sometimes used. The length is also, generally, almost universally, nine feet.

In England, retorts are almost always circular in section, and eighteen to twenty inches diameter; and generally, but not universally, eighteen feet in length, and open at both ends. Some differences of climate—the extreme heat of our summers, and the extreme cold of our winters—make the closed retort preferable in this country, and the ⌓ retort is supposed to produce the larger quantity of gas from the coal by more perfect "*carbonization.*" Iron retorts of the same internal dimensions as the clay ones were formerly used. Although clay retorts were introduced before 1820, in Great Britain, yet their general adoption did not occur until about 1850, and their general use here was quite ten years later.

The Philadelphia gas works continued the use of iron retorts longer than any other works in the world. Clay retorts require the use of "exhausters" (or pumps, which in this country are generally rotary) to remove the gas as fast as formed, to produce a satisfactory yield or quantity of gas from the coal. Iron retorts are yet used for very small gas works, where not over four or five retorts are required to supply the quantity of gas needed.

Retorts have a "*mouth-piece*" of iron, of the same shape as the retort, attached by bolts to the mouth end. This mouth-piece is about one foot long, and has both ends open, one to attach to the retort, and the other to be covered by a lid, which lid is held against it by a central screw; there being "*lugs*" (ears) on the sides of the mouth-piece, which carry a "*cotter bar*" (cross-bar of iron) for the screw to go through. On the top or side of the mouth-piece is a "*bell*" (socket) for the stand-pipe.

The retorts are placed horizontally in "*benches*" (nests) of five, (six is as usual in large gas works: while one, two or three are placed in smaller ones,) and are built into an arch-way of fire-brick, nine and a half feet deep by about six and a half feet wide, and six or seven feet high, under the centre of the arch. The arrangement of retorts in the benches is two at the bottom, with a narrow fire-place three and a half or four feet long between them; two above, a little close together; and one in the middle on top. They are supported by the wall in front, and by "blocks" of fire-brick in the middle and at the back end; so the heat from the fire will rise over them, to the top of the arch, and the gases of combustion will finally escape at the flue holes; which open into the chimneys in the back wall, the holes being below the bottom of the lowest retorts. The chimneys are ten or twelve feet high only. The iron mouth-pieces project and stand in front of the wall.

The benches are placed in "*settings,*" or a number of benches or arches are contiguous; and the settings at the Philadelphia gas works, and in all large works, are placed back to back; making "*double settings.*" In the retort houses of the Philadelphia works at Market street, there are six double settings of fifteen benches of fives (12" by 20" by 9'), or nine hundred retorts in all.

The bench is heated to a clear white heat, and never allowed to cool while in service for the production of gas. The coal is brought in wagons of such size as will carry a "*charge*" for the five retorts, in readiness for charging them; and the process of continuous working is as follows: The workmen first "*draw*" (discharge) the coke; commencing by loosening the cotter-bar screw, which breaks the joint of the lid with the mouth-piece; they next light the gas, which begins to escape at the crack, and burn off all that will come out; then removing the lids, the flame enters the retorts and frees them from gas on the inside; a hook of iron is now introduced, and the red-hot coke, just below incandescence, is drawn out upon the floor in front of the retort; where it is quenched with water, so that it will not continue to burn in a pile, and then shoveled up into a "*coke-barrow*" and removed to the coke-heap. This operation is substantially the same in all gas works. Generally, perhaps, the hot coke is drawn into a wagon and removed to be cooled outside of the retort-house; a procedure which greatly increases the orderliness of the house; and sometimes the whole retort-house has a cellar beneath it, into which the coke is dropped to be quenched.

I do not know of any other large gas works, except those of Philadelphia, where the coke is quenched in front of the retorts. At these works the yard is open to the Schuylkill, and the coke heap exposed to public view from Market street bridge, and it is probable that the quenching at the heap would be too demonstrative of steam and black dust to make it advisable to quench outside. As it is, the ventilators along the roofs of the retort-houses, are but very little above the level of Market street, and very much below the level of the buildings adjacent to the gas works, (within three hundred feet distance,) many of which are dwellings; and consequently the steam from quenching, laden with coke-dust, and charged with burned and unburned gases, escapes at the ventilators, and is swept by any northerly wind, across Market street: at times nearly obscuring the way. The greater part of this nuisance would be avoided by the construction of a suitable coke-house with quenching apparatus, and a tower sufficiently high to condense the vapor and to carry off the gases above the buildings, where they could safely diffuse.

In New York, at the several gas works which I examined last week in this regard, the quenching of coke is but little better provided for; but as the works are all on a level with streets and adjacent property, and as any one of the streets themselves is by no means the principal thoroughfare of the city, the nuisance is tolerable. At the Manhattan works, in New York city, (Tenth avenue and West Eighteenth street,) the quenching is done out of doors, in an open yard, beside a wall that is twelve or fourteen feet high, on the line of West Seventeenth street, which street is eighty feet wide and close to the North river, where the largest part of the travel is coal und dirt carts. At the New York gas works (Avenue A and East Twenty-first street), the quenching is done in the middle of the works. the coke being removed to a floor away from the retorts.

The retorts having been emptied of the coke from the former charge, they are now filled by shovels with coal from the wagon. In most works they are filled by "scoops," or long, half-pipe vessels, which will contain either a half charge (when two scoopfuls are used); or, with large scoops, holding the entire charge. The saving of time, the preservation of heat in the retorts, is the result of scoop-feeding as compared with shoveling. Recently attempts have been made to substitute mechanical feeding and drawing for hand work, but after eight years' trial in Great Britain only a degree of success has been attained.

The task will undoubtedly be accomplished at some not very far-off day, and at the New York gas works they have a retort-house, nearly completed, with a locomotive mechanical "*charger.*"

The charge for a twelve by twenty inch retort is, for four-hour charges, two hundred pounds of coal; for four hours and forty-eight minutes (or five charges in twenty-four hours), two hundred and forty pounds; but these quantities are exceeded by some, if not most, gas works managers—not, however, beyond ten or fifteen per cent. The *charges* of retorts are called four-hour or five-hour, (four hours forty-eight minutes), to designate that so much time is allowed to work a *charge* of coal and replace the coke by another; that is, in the one case six repetitions of the operation are made, and in the other five, in the course of twenty-four hours. At the Philadelphia works, an entire bench of five retorts is open at once, and this practice is usual in gas works in the United States; but in England only a single retort (a through retort) in any bench, is drawn at once. As there are fifteen benches on each side of each setting at the Philadelphia works, the same workmen will draw from bench to bench, one after another, so that the operation of drawing retorts becomes practically continuous for, perhaps, half of every hour of the time during the day and night; the intervals being only those demanded by the endurance of the workmen at such hot and severe labor.

Having removed the coke and inserted the charge, the lids are closed, the joint being made by a "luting" of clay and spent-lime, spread upon the edge of a cold lid, ready to replace the hot one, and the cotter-bar screw completes the operation of the "*stoker.*" Lids without clay joints, in various forms, have recently come into use, with much saving of time and leakage; and one of these is being introduced at the Philadelphia works.

The enclosed coal rapidly acquires the heat of the retort; at first the products of distillation, are the vapor of water (steam) and the oily hydro-carbons not very completely decomposed; afterwards the gaseous substances separate; and, after three and a half to four and a half hours, little, except pure hydrogen, passes over. These volatile products pass out through the "stand pipes," which are six to seven inches in diameter and eight to twelve feet high, being socketed to the mouth pieces. At the top of the stand pipes are "*bridge pipes,*" which are U shape, one leg joined to the stand pipe and the other joined to, and entering into the "hydraulic main."

The "*hydraulic main*" is a long trough pipe, with a covered flat top; it is about two feet wide and three feet deep, and runs the whole length of each *setting*, resting over the front part of it. The leg of the bridge pipe (U), which joins the cover of the hydraulic main, enters into it for half the depth, or one and

a half feet, and is called the "*dip-pipe.*" The hydraulic main is permitted to fill a little more than half full of tar and ammoniacal liquor, (mostly tar, as the ammoniacal liquor runs out first over the bridge at the end of the hydraulic main), and the end of the dip pipe is thus immersed ("*sealed*") by the tar, from one-half inch to one inch; and any gas which passes up the stand pipe, over the bridge pipe and down the dip pipe, must bubble up through one-half inch to one inch of tar, to get into the upper part of the hydraulic main. The chief purpose of the hydraulic main is to prevent an escape of gas backwards, down the stand pipes, when a retort lid is removed; and this purpose is affected by the pressure of the gas in the hydraulic main, which, pressing on the liquor outside of the dip pipe of an open retort, lifts up a column on its inside, and stops off the flow of any gas; but the stand pipes and the hydraulic main answer the further purpose of a hot condenser, giving time enough and surface enough for most of the tar to separate out of the crude gas in them, in place of going over to be cooled together; when the tar would be likely to extract the luminous gases or vapors, very completely. Beside, the first oils which are made in the beginning of the process of distillation are condensed in the stand pipe, and run back into the retort to be destructively distilled afterwards.

There collects in the stand pipes, and runs down at the last end of the process a small quantity of stiff tar, which lodges in the bottom of the mouth piece; this is usually collected (scraped up) and put into the next charge of coal. Some of this coal tar had been thrown out with the coke on the occasion of one of my visits to the gas works, and produced at the coke heap the characteristic odor.

[§ § *Two.*] At the Market street works, the tar and ammoniacal liquor are conveyed, from the ends of the six hydraulic mains by pipes nowhere open into the air, into a large tar well, which is a vat formed by a liquor tight cellar of one of the buildings used for storage of lids, castings, and materials of various kinds; the floor, which forms the cover or top of this vat, is brick arches, covered by iron braces. This vat seemed to be about fifty by eighteen feet, by seventeen feet deep, inside measure, and in it these offensive by-products are thoroughly and satisfactorily isolated. The tar having settled and become free of ammoniacal liquor, is then removed by a steam pump, and taken across, as wanted, to a temporary building, in which is placed some distilling apparatus for recovery of the oils and separation of the pitch.

Upon the whole, this coal tar distillery apparatus and its mode of working appeared to me to be quite satisfactory. Some of the vats ought to be closed better than they now are, and some other precautions should be taken to prevent nuisance of smell from spilled oils; but I must regard this treatment on the spot to be far more likely to remove causes for complaint than any mode of removal possible to make. I think it would be impossible to convey the tar away by pipes or otherwise, without the risk, and almost certainty of greater annoyance to the public than now exists.

[To be concluded.]

Price of Gas.

In reply to our request in the last number of the Journal, we have received quite a number of answers We hope that all those who have not yet sent us the price at which they sell gas, will not fail to do so at as early a day as possible. It is proposed to continue the list so as to make the record complete.

The following prices are *official*, having been furnished to the American Gas-Light Journal by the officers of the various Gas Companies.

Albany (Peoples) N. Y.	$2.75	
Annapolis, Md.	3.40	
Atchison, Kansas.	4.50	
Austin, Texas.	6.00	
Allegheny City, Pa.	1.80	20 p. ct. off prompt pay
Albany, N. Y.	2.75	
Ashland, Ohio.	3.50	Street lamps 4½ hours 17 nights per month, $15 per annum.
Brooklyn, B'klyn.	2.75	
" Citizens.	2.75	
" Nassau.	2.75	
" Metropol'an	2.75	
" Peoples.	2.75	
" W'msburgh	2.75	
Brockton, Mass.	3.80	
Batavia, N. Y.	3.00	
Bridgton, N. J.	3.50	
Bangor, Me.	3.00	
Boonville, Mo.	4.50	
Brownsville, Tenn.	4.50	
Belfast, Maine.	4.00	10 p. c. off bills over $10; 5 p. c. off bills under $10.
Brockville, Ontario.	3.75	
Bloomfield, N. J.	3.75	
Belleville, Ill.	3.50	
Bellaire, Ohio.	2.85	5 p ct. off prompt pay.
Barnesville, Ohio.	3.00	5 p ct. off prompt pay. Street lamps $17.50 per ann. Burn till 12 P. M. on moonless nights.
Cleveland, Peoples, O	2.00	
Cumberland, Md.	3.00	
Charleston, W. Va.	4.00	25 p. ct. off prompt pay Meter rent 25, 30, and 50 cents. per m. for 3, 5 and 10 light.
Cincinnati, Ohio.	2.25	
Columbia, Mo.	4.50	
Carondolet, South St. Louis, Mo.	3.00	5 p. ct. off prompt pay,
Chattanooga, Tenn.	3.00	
Cold Water, Mich.	3.25	
Chicago, Ill.	2.50	
Columbia, Pa.	2.85	Lowe process.
Charlottesville, Va.	3.50	Meter rent 20 cents.
Cedar Rapids, Iowa.	4.50	50 cts p M. off prompt pay.
Cairo, Ill.	3.75	50 cts added if not paid by the 5th.
Cortland, N. Y.	4.00	25 cts p M. off prompt pay.
Derby, Conn.	3.60	10 p. c. off prompt pay, and 50 cts per M. on excess of 5000 ft. per month.
Decatur, Ill.	3.50	50 cts. per M. added, if not paid by 10th.
Danbury, Conn.	4.28	For less than 5000 per month.
" "	3.85	For over 5000 per m'th
Dover, Del.	3.60	
East Boston, Mass.	3.00	
East St. Louis, Ill.	3.50	5 p. c. off prompt pay.
Evansville, Ind.	3.00	City lamps $30.
Erie, Pa.	3.00	City lamps $28 p. an.
Elkhart, Ind.	3.50	
East Newark, N. J.	4 00	
Eastchester, N. Y.	3.50	
Elizabethtown, N. J.	3.00	
Fredericksburg, Va.	3.40	
Flint, Mich.	3.50	
Franklin, Pa.	3.00	
Fall River, Mass.	3.00	
Freeport, Ill.	3.80	
Guelph, Ontario.	3,50	
Geneva, N, Y.	2.50	5 p. c. off prompt pay. Wood and oil gas.
Greensboro, N. C.	4.00	
Galena, Ill.	4.50	Meter rent 25 cts. per month.
" "	4.00	After September 1st.
Huntsville, Ala.	3.50	
Hempstead, L. I.	4.00	
Huntingdon, Pa.	3.80	10 per ct. off prompt pay.
Hagerstown, Md.	3.75	
Hamilton, Ohio.	4.00	
Hillsdale, Mich.	3.50	
Holyoke, Mass.	3.01	
Ithaca, N. Y.	4.00	5 p. c. off prompt pay.
Indiana, Pa.	3.00	10 p. c. off prompt pay. Meter rent 10 cents per month.
Jersey City, N. J.	2.75	
Joliet, Ill.	3.50	
Jacksonville, Ill.	4.00	12½ p.c. off prompt pay.
Jefferson City, New Orleans, La.	4.00	
Knoxville, Tenn.	3.00	Meter rent 15 cents.
Lyons, N. Y.	4.00	
Lima, Ohio.	3.80	
Lynchburgh, Va.	3.00	5 p. ct. added to bills not paid in 5 days.
Louisiana, Mo.	4.50	
La Crosse, Wis.	4.50	50 cents per M. off prompt pay.
Lancaster, Pa.	3.00	
Louisville, Ky.	2.70	5 p. c. off prompt pay.
La Porte, Ind.	3.50	Wood and oil gas.
Lowell, Mass.	2.50	
Millville, N. J.	3.12	
Milford, Del.	3-50	
Marquette, Mich.	3.50	
Morris, Ill.	2.00	For 15 candle power or $10 per M. coal gas meter measure (Petroleum Gas—Wren's patent).
Meriden, Conn.	3.93	
Marietta, Ohio.	3.50	20 cts. per M. off if paid by 6th. Consumers over 3000 ft. 30 cts. additional discount.
Marshalltown, Iowa.	4.50	50 cts p M. off prompt pay.
Meadville, Pa.	3.50	25 cts p M. off prompt pay.
" "	2.50	For over 10,000 ft. per month,
Monroe, Mich.	3.50	5 per ct off prompt pay
New York, New York.	2.50	
" " Harlem.	2.75	
" " Manhattan	2.50	
" " Mutual.	2.50	
" " Mropolitan	2.50	
" " Municipal.	2.50	Water Gas.
Nashville, Tenn.	2.85	
Newark, Citizens, N.J	3.00	5 p. c. off prompt pay.
Norfolk, Va.	3.10	
New Brunswick, N. J.	2.70	
Newton, N. J.	4.00	
North Attleboro, Mass.	3.50	
New Britain, Conn.	3.70	
New Haven, Conn.	2.75	
Nantucket, Mass.	3.00	Meter rent 15 cts. p. m.
Newark, N. J.	2.85	
Niagara Falls, N. Y.	3.50	20 cts p M. off prompt pay.
Norwalk, Conn.	4.00	12½ p ct off prompt pay.
Oswego, N. Y.	3.15	5 p. c. off prompt pay.
Ottawa, Ill.	4.00	12½ p. c. off prompt pay
P'keepsie, Citizens.	2.70	Gwynne Harris process
Paterson, N. J.	3.80	10 p c. off prompt pay, and in addition 5 p.c. on bills of $200; 10 p. c. on bills of $1000
Portchester, N. Y.	3.50	
Pittsfield, Mass.	3.50	5 p. c. off prompt pay, and 10 p. c. off on bills of $350 per an.
Portland, Me.	3.00	
Paris, Ky.	4.50	Meter rent 25 cts. p m
Portsmouth, N. H.	3.22	
Pittsburgh, Pa.	1.00	
Philadelphia, Pa.	2.15	
Painesville, Ohio.	3.50	
Pawtucket, R. I.	3.00	Over a million feet a year $2.70.
Providence, R. I.	2.25	
Pottsville, Pa.	3.50	10 p ct off prompt pay.
Plainfield, N. J.	3.50	5 p ct off for less than 5000 a month. 10 per cent more than 5000 a month.
Peoria, Ill.	3.50	
Quincy, Citizens, Mass.	5.00	
Quincy, Ill.	3.50	
Quebec, Ont.	2.40	
Rome, N. Y.	3.60	
Rochester, N. Y.	3.00	
" Citixens.	3.00	
Rondout, N. Y.	3.60	
Syracuse, N. Y.	2.75	
Springfield, Ill.	3.25	$25 for city lamps.
St. Joseph, Mo.	4.00	12½ p. ct. off on bills over $100 p. month.
St. Albans, Vt.	5.00	10 p. c. off prompt pay, and in addition 5 p. c. off bills from $50 to $100 per month; 10 per. ct. off bills over $100.
Sandusky, Ohio.	3.00	
Saratoga, N. Y.	5.00	20 p. c. off prompt pay, Nov. 1st to May 1st. 10 p. c. rest of year.
San Antonio, Texas.	7.00	10 per ct off from 10 to 20,000 per month 20 p ct off from 20,000 and upwards.
St. Charles, Mo.	4.50	
Sidney, Ohio.	3.25	
Steubenville, Ohio.	2.50	
Sherman, Texas.	5.00	5, 10, 15 and 20 p. c. off, according to quantity.

Salem, Oregon	7.00	October last reduced from $8.
Salem, Ohio	2.75	Meter rent 12½ cts if 300 feet is not used monthly
Sedalia, Mo	3.50	
Sharon, Pa	3.15	5 per ct off on less than 5000 feet per month. 10 p ct from 5 to 15 M. 15 p ct from 15 to 20 M. 20 per ct over 40 M.
Tiffin, Ohio	3.00	
Titusville, Pa	3.00	
Vicksburgh, Miss	4.50	
Wilkesbarre, Pa	3.50	10 p. c. off prompt pay.
Worcester, Mass	3.00	5 p. c. off on $500, and 10 p. c. off on $1000 in six months.
Westfield, N. Y	4.00	10 p. c. off prompt pay.
Washington, D. C	2.25	
Watertown, N. Y	4.50	10 p. c. off prompt pay.
Wheeling, West Va	2.25	10 p ct off prompt pay.
Washington, Pa	2.50	
York, Pa	3.00	Meter rent 12½ cents.
Youngstown, Ohio	2.50	10 p. c. off on bills of $50 per month.
Zanesville, Ohio	2.70	10 p. c. off on bills of $25 per month; city lamps $23.

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 Pine Street, New York City.

April 17, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked*
Harlem	$1,850,000	50	115	120
Manhattan	4,000,000	50	255	260
Metropolitan	2,500,000	100	145	150
" Scrip	$1,000.000	..	102	---
" Bonds	500.000	1000	104	---
Mutual	5,000,000	100	108	109
" Bonds, gold.	900,000	1000	105	---
New York	4,000,000	100	135	149
Central, Westchester	466,000	50	100	105

Gas Co.'s of Brooklyn.

Brooklyn	2,000,000	25	190	195
Citizens	1,200,000	20	90	100
" Scrip	320,000	1000	95	100
Peoples	1,000,000	10	60	65
" Bonds	$ 325,000	...	---	95
" Scrip	300,000	...	85	--
Metropolitan	1,000,000	100	—	75
Nassau	1,000,000	25	90	95
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	—	—
" Scrip		...	96	100

Out of Town Gas Companies.

Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	—	90
Baltimore, Md	2,000,000	100	178	186
" Ctfs., gold	1,000,000		105	—
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	87½	—
" " Ctfs.	53,000	—	—	—
" " Bds.	124,000	—	—	—
Derby of Conn	160,000	100	...	80
East Boston, Mass		25	132	---
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	41	—
Hempstead, L	25,000	100	...	—
Jersey City	386,000	20	160	170
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	33	—
Lima, Ohio	60,000	100	85	...
" Bonds	30,000			
Laclede, Mo	1,200,000	100	---	115
Peoples, Jersey City		...	125	135
Peoples of Albany	650,000	100	31	—
" Bonds	350,000	1000	--	--
Peoples of Baltimore		25	101	102
" Bonds			106	—
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	—	—
Fort Wayne, Ind		100	...	—
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
t. Louis, Missouri	600,000	50	110	130

The following stocks were sold at auction—

20 shares Metropolitan, N. Y., @ 146½; $1440 scrip of same company, @ 102¼—102¾; 115 Manhattan, N. Y., @ 258½—260½; 400 Peoples, Brooklyn, @ 62; 100 Mutual, @ 108; $9,000 Citizens, of Rochester, 7% coupon bonds, due 1883, interest March and September, @ 81¼.

We note sales of $3000 Boston Gas Light Company's 6% bonds, @ 105.

PRICES OF FOREIGN AND DOMESTIC GAS COALS.

[Reported Expressly for this Journal.]

April 17, 1876.

DELIVERED IN NEW YORK.

English Cannel.			
Ince Hall	$17 00	@	18 00
Kirkless Hall	16 50	@	17 00
English Caking Coals.			
Newcastle Gas	$5 50	@	00 00
Liverpool caking	11 50	@	12 00
British Province Coals.			
Pictou			2 00
Block House—At Mines, $1.87, Gold			2 00
Caledonia—At Mines, $1.50, Gold			0 00
Little Glace Bay—At Mines, $1.75, Gold			0 00
Lingan—At Mines, $1.75, Gold			0 00
Sydney—Old Mine			3 00
" Reserve, $1.75, Gold Mine			0 00
" International			— —

Duty, 15 cents per ton, gold. Freight to New York $2 00 currency. Cost of above coals delivered in New York, $4 75 @ $5 00, currency.)

Pennsylvania Coals.			
Penn Gas Coal—At Amoy	$5 60	@	0 00
Westmoreland—At Amboy	5 60	@	0 00
Shafton	5 60	@	0 00
(In New York, the above coals $6 00)			
Youghiogheny	6 00	@	0 00
Waverly	6 00	@	0 00
West Virginia Coals.			
MurphyRun	6 50	@	0 00
Despard	6 50	@	0 00
West Fairmont	6 50	@	0 00
American Gas Coal	7 40	@	0 00
Fairmont	6 50	@	0 00
Newburgh Orrel	6 50	@	0 00
Pinnickinick	6 50	@	0 00
Cloverhill of Virginia	6 00	@	6 50
McKenzie Compound Mixture			— —
American Cannel Coals.			
Peytona of West Virginia	$12 50	@	00 00
Darlington of Pennsylvania			— —
Cannelton Cannel			11 00
Red Bank—at Philadelphia			6 50
" —at South Amboy			7 25
Asphalts.			
Albertite of New Brunswick	$21 00	@	— 00
Trinidad Bitumen	— —	@	14 00

The Penn Gas Coal Company have contracted with the Pittsburgh Gas-Light Co. for their entire supply for the ensuing year from their Youghiogheny mines.

Within the last week contracts have been made by some of the companies in New York for about 200,000 tons of Penn, Westmoreland, Waverly, Youghiogheny, and the West Virginia caking coals—at $6 00 per ton a reduction of 50 cents from last years' prices.

NEW YORK SHOVEL WORKS.

MANUFACTURERS OF

SHOVELS, SCOOPS & SPADES.

SHOVELS AND SCOOPS A SPECIALTY

For Gas-Light Companies.

DEAN'S PATENT

COKE SCREENING SCOOPS.

Frames are 12 by 18 inch, seven bars, best Malleable Iron. They can be made to screen any size desired.

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404-1y

Brooklyn Clay Retort

AND

FIRE-BRICK WORKS,

VAN DYKE STREET, BROOKLYN, N. J.

EDWARD D. WHITE, Surviving Partner of the late firm of J. K BRICK & CO. 402-1y

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IMPROVED RETORT SETTINGS,

GUARANTEED TO HEAT UNIFORMLY WITH THE MINIMUM OF FUEL.

Colored lithograph copies of working drawings of beds of 1, 2, 3, 5, 6 and 7 retorts each, so clearly arranged and fully shown, as to be easily understood by any retort setter or bricklayer, having just been made of these valuable settings, they can now be supplied, with detailed specifications, immediately on receipt of orders.

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TO GAS COMPANIES, AND CITY GOVERNMENTS.

DYOTT'S PATENT

CHAMPION STREET LAMP

Doubles the Light with the same quantity of Gas used in other Lanterns. *All others* waste half their light, illuminating the sky, or if the top is of metal, absorb it.

Single Top Glass Lamps both Globular and Square become heated if a good light is put in them, and rain, hail or snow falling upon the heated glass breaks it. When one glass is broken the wind will either blow the flame against the others and break them, or destroy the entire Lamp. *Nine-tenths of the breakage and cost of repairs of other* street lamps is owing to that cause.

Dyott's "Champion" is the only double top—the only Lamp that has the Opaline White Dome, which is a *never changing reflector;* it doubles the power of, and throws the light to a greater distance. It is also a perfect *protector,* shielding the heated top or the lamp from all inclemency of the weather. The white dome is kept cool by the passage of air between it and the transparent globe below. Rain, hail or snow will never break either the globe or dome. The globe rests upon rubber cushions, and is supported laterally by elastic springs, so that contraction or expansion of the globe, or jarring of the post will not break it. They can be cleaned in one-fourth the time required to clean other lanterns. The metallic portions are of iron, copper and brass, and are the most durable, economical, efficient and cheapest lamps in existence. For public buildings, and wherever an ornamental and powerful light is required, they are made in clusters of 2, 3, 4, 6, 7 and 10 lamps, which have no equal in this or any other country for *beauty, durability, efficiency* and economy, either in cost, use or ornamentation. Designs furnished when requested for specific purposes. Gas companies, or those who have the lighting of Cities in charge, are solicited to communicate with us in reference to the agency for its introduction.

The Franklin Institute has awarded our Champion Lamp the highest premium: (they give a silver medal) and its Committee on Science and the Arts has recommended it as the best lamp in use. It has also invariably taken the highest premium at every Exhibition at which it has been presented, and elicits the strongest commendations wherever it is used. We have several new and handsome patterns of Posts for Corporations, Parks, public and private use, also for clusters of lamps, that are not excelled in beauty or price at which they are furnished. DYOTT MANUFACTURING CO.,
374-6meot 114 South 2nd Street, Phil'a, Pa.

A Gas Engineer

of experience, who is a practical Mechanic, wants employment. Would lease a small Gas Works. Address GAS ENGINEER, 359 West 31st Street, N. Y. 403-1t

THE SUBSCRIBER WOULD LIKE A SITUATION AS FOREMAN, or would take charge of a small Gas Works. Address S. H. DOUGLASS, New Haven, Conn., Gas Works. 143-tf

FOR SALE,

A PURIFYING APPARATUS, CONSISTING OF A SIX inch Condenser of 24 columns, 20 feet high, with By-Pass; four Set Washers, 12 inch diameter by 9 feet high, with By-Pass; four round Purifiers 6 feet diameter by 3 feet deep; seven tiers of Trays (cast iron), Covers and Counter Balances, and one 6-inch Dry Centre Valve and Connections.

The above Apparatus is in first rate order, and will be sold cheap. For particulars address

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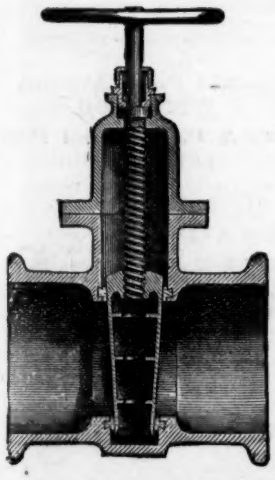
CHAPMAN GAS VALVES.

Office and Sales Room 75 and 77 Kilby Street, Boston.

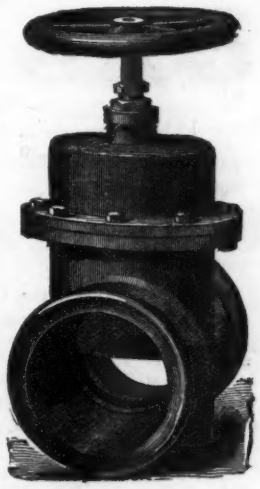


These Valves have been in use for several years, and are pronounced by all who have used them to be

The Best Gas Valves Ever Made.

They afford a direct passage the full size of the pipe. The seats are made of an alloy similar to BABBITT metal, specially prepared for the purpose, and superior to all other metals used for the seats of Gas Valves. It does not corrode under any circumstances to which it is exposed.

There is NO LIABILITY OF COHESION between the Gate and Seat, and the Valves can be relied upon to SHUT TIGHT and OPEN EASILY at all times—an important desideratum when used for street mains, in cases of fire.



We refer to the following named Gas-Light Companies among the many that have used these Valves:

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CAMBRIDGE GAS-LIGHT COMPANY, CAMBRIDGE, MASS.
NEWTON & WATERTOWN GAS-LIGHT CO., WATERTOWN, MASS.
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PEOPLES GAS-LIGHT COMPANY, BROOKLYN, N. Y.
CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
SOUTH BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CHARLESTOWN GAS-LIGHT CO., CHARLESTOWN, MASS.
LYNN GAS-LIGHT COMPANY, LYNN, MASS.
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WILLIAMSBURGH GAS-LIGHT CO., WIRLIAMSBURGH, N. Y.

GAS AND WATER VALVES ¼ INCH TO 36 INCHES DIAMETER.
STEAM VALVES ¼ INCH TO 12 INCHES DIAMETER.

857-tf

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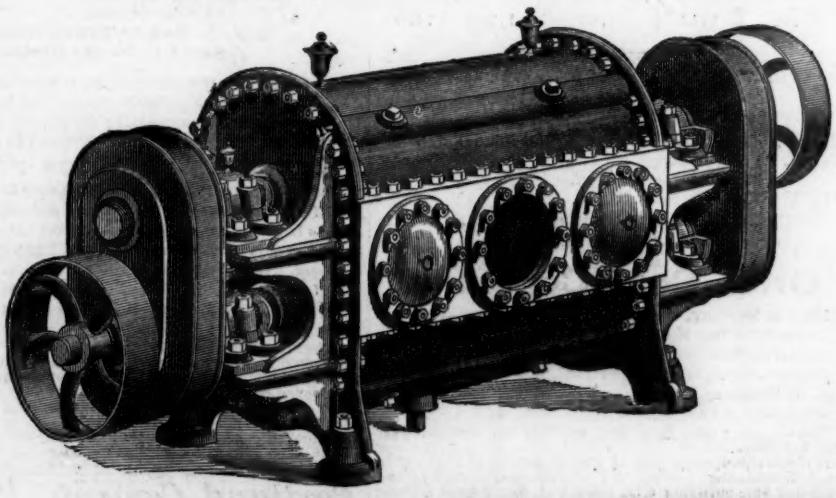

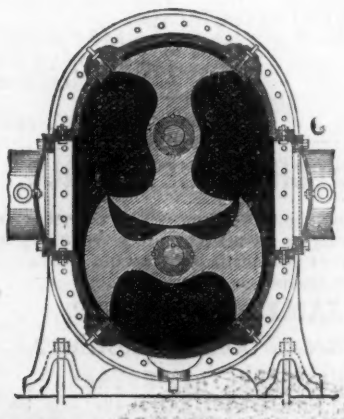

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The following are some of the advantages we claim for this Exhauster over all others:

FIRST.—It is simpler in its mechanical construction than any other Exhauster in use.

SECOND.—The internal parts consist of only two revolvers, each cast entire in one piece, without a single screw, bolt, nut, washer, key or other part to get loose on the inside and stop or break the machine. The internal operating parts, therefore, can not get out order and hence require no care or attention.

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FIFTH.—They are built in the most complete and substantial manner, with steel shafts and improved journal bearings, and their durability is almost without limit.

We build them of any required capacity, large or small, adapted to any kind of works or place.

Send for Illustrated Catalogue, giving all particulars as to capacity, speed, power required, dimensions, and price of each size and references to parties using them.

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THE
PENN GAS COAL COMPANY

OFFER THEIR

COAL, CAREFULLY SCREENED,

AND PREPARED FOR

GAS PURPOSES.

Their Property is located in the Youghiogheny Coal Basin, near Irwin's and Penn Station, on the Pennsylvania Railroad, and on the Youghiogheny River.

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OF WEST VIRGINIA.

Offer for sale the following Coals, from their Colliery at CANNELTON, Kanawha County, West Virginia, delivered at RICHMOND, Va.:

CANNELTON CANNEL,

cknowledged to be the most valuable ENRICHER produced in this country, a gross ton yielding 10,000 ubic feet of GAS of 64·54 CANDLE POWER; COKE 32 bushels, of good quality.

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Volatile Matter.	Coke.	Per cent. of Ash in		Sulphur in			Specif. Gravity.	
		Coal.	Coke.	Coke.	Oötl.	Volatile Matter.	Coal.	Gas.
35.1	64.9	2	6	.82	1.48	.66	1,289	.476

MAXIMUM YIELD, 5.06 cubic feet of Gas per pound of Coal—A yield of 4·78 cubic feet per lb.. —gave 16 14-100 Candle-Power.

COKE, of very fine quality—1453 pounds produced from one ton of coal.

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THE SUBSCRIBER IS PREPARED TO CONTRACT FOR the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES McKELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

ESTABLISHED 1840. 357-1y

WREN'S GAS WORKS.

W. C. WREN,

Corner of Jay and Water Streets,

BROOKLYN. N. Y.

HAVING GRANTED THE USE OF ONE OF my Patents to the Gas-Light Company of America, and settled my claim against them, I inform the profession that I continue to erect the Works known as

Wren's Gas Works,

and sell Licenses to use my Patents for making Gas from Petroleum.

Gentlemen of the profession:—As your consumers demand a better light, and as that demand has been in many cases sought in vain to be met by using different abortive imitations of my various processes, would it not be well to make success sure by trying the plan of the inventor.

You can enrich your Coal Gas to any desired standard, by using my process, in the simplest manner, and much cheaper than by *any other* method. Address as above. 397

THE NEWBURGH

Orrel Coal Company,

Mines at Newburg, Preston County, W. Va.

Company's Office, No. 52 S. Gay Street, Baltimore, Md.

C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.

CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

SINCLAIR & AGNEW, Agents, Alexandria, Va.

This Company offer their very superior Gas Coal at lowest market prices.

It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.
294-1y B

THE DESPARD COAL COMPANY

OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

Agents, PARMELEE BROTHERS, No. 52 Pine street, N. Y.
BANGS & HORTON, No. 31 Duane street, Boston.
Mines in Harrison County, West Virginia.
Wharves Locust Point, Company's Office, 15 German St., } Baltimore.

Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine.

*** Reference to them is requested. 204-1y

NEW YORK AND CLEVELAND
GAS COAL COM'Y

Of Pittsburgh, Pa.

MINERS AND SHIPPERS OF

YOUGHIOGHENY GAS COAL.

This Company is prepared to furnish any amount of their justly celebrated, and acknowledged superior GAS COAL, to any point reached by railroad or navigation, on most favorable terms.

General Office—384 Penn Avenue,
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PEYTONA
CANNEL COAL

From West Virginia.

Yields over 13,000 feet of Gas per ton. At ten thousand feet (standard yield) the illuminating power is over 43 candles. Purifies 4,510 feet to the bushel of lime.

S. E. LOW, Secretary,
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OFFICE OF THE

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A. H. ALLEN, Secretary.
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This Company is the owner of the GWYNNE-HARRIS, or AMERICAN HYDROCARBON process, for making Gas for Lighting or Heating purposes, by the perfect decomposition of superheated steam, under what is known as the

GWYNNE AND HARRIS PATENTS.

This process has been fully tested nearly 50,000,000 cubic feet of Gas having been made under it, and fully demonstrating the fact that it is the greatest improvement ever made in the manufacture of Gas, either for Lighting or Heating purposes. With half a ton of Anthracite Coal 150,000 cubic feet of Gas per day is made from three benches, and the labor is so small that one man can attend three or four benches.

The process can be put into either Coal or Oil Gas Works (or where both Coal and Oil are used) at small cost, without any interruption to the working of other benches. The Citizens Gas-Light Company of Brooklyn, after using it for more than seven months, have found it not only far better, but actually *cheaper* than atmospheric air in making Gas, with the use of "petroleum and its products."

Further information, and terms of sale of rights will be given, upon application to the Company 348-1y

Portland Cement,
Roman Cement,
Keene's White Cement,

NUMBERS 1 AND 2.

From best London Manufacturers.

FOR SALE BY

S. L. MERCHANT & CO.,

76 South Street, New York,
Corner Maiden Lane. 344-1y

☞ Remit 10 cents postage for "Practical Treatise on Cement."

B. E. CHOLLAR,
GAS ENGINEER,

914 OLIVE STREET, ST. LOUIS, MO.

355-

THE WAVERLY COAL AND COKE CO.

Offer for Sale the

YOUGHIOGHENY COAL

DOUBLE SCREENED,

from their Colliery at Smith's Mills, on the Youghiogheny River, thirty-seven and a half miles southerly of Pittsburgh. This Coal has the preference in Pittsburgh over all other YOUGHIOGHENY COAL for GAS PURPOSES.

The facilities of the WAVERLY COMPANY are unsurpassed by those of any other Company on the Youghiogheny.

Full particulars can be had by addressing

PERKINS & JOB, Agents,
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1852 TROY, N. Y., 1876.

MANUFACTURERS

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SABBATON

Coke Shovels,

WITH EITHER

Long or D Handles.

WELL KNOWN AMONG

The Principal Gas Companies throughout the Country.

PRICES REDUCED, and Shovels delivered in New York per lots of one dozen or more.

Orders solicited. 399–6

REMOVAL.

BUTLER'S PATENT

Coke and Coal

SCREENING SHOVELS

MADE FROM BEST MALLEABLE IRON AND STEEL.

FURNISHED WITH LONG OR D HANDLES

Perfect in their operation, is very strong, and from their great durability vastly more economical than any substitute. Refer to all the principal gas Companies in the country, who acknowledge them as the "ne plus ultra of Coke Screening Shovels.

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HERRING & FLOYD,
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740 Greenwich St., N. Y.

☞ I still retain the original SABBATON LETTERS PATENT, and have granted no rights or privileges to any other parties.

J. H. GAUTIER & CO.,

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GREENE AND ESSEX STREETS,

JERSEY CITY, N. J.

MANUFACTURERS OF

Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.

Ground Clay, Fire Brick and Fire Sand in Barrels,

ALWAYS ON HAND.

J. H. GAUTIER.
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FOR WATER AND GAS,

ALSO,

GAS WORKS AND MACHINERY CASTINGS

OF EVERY DESCRIPTION,

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RILEY A. BRICK. W. W. CAMPBELL.

Gas Engineers,

AND PARTIES ENGAGED IN THE BUILDING OF

GAS WORKS,

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J. D. PATTON,
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FOR SALE,

200 Tons
CANNEL CHIPS.

Address **H. E. HOY,**
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CHAS. H. MEYER & CO.,

227 Chestnut Street, Philadelphia, Pa.,

IMPORTERS OF

LAVA TIPS AND SCOTCH TIPS.

ALL ORDERS DELIVERED FREE TO NEW YORK.

859-1y

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American Meter Co.—West 22nd st., N. Y., Arch and 22d st., Phil., 548 Washington st., Boston.
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Gas-Burners—C. Gefrorer, 248 North 9th st., Phila., Pa.
Gas Purification—St. John and Cartwright.
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Gas Meters, etc.—Wm. W. Goodwin & Company, 1012 Filbert street, Phila, Pa.
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Gas Fixtures, Etc.—Mitchell, Vance & Co., 597 Broadway
Clay Gas Retorts, etc., etc.—J. H. Gautier & Co., cor Greene and Essex streets, Jersey City, N. J.
Gasholders, Etc.—Deily & Fowler, 39 Laurel st., Phila., Pa.
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Lime Hurdles.—Manhattan Lime Hurdle Co., Geo. W. Day, Treas., No. 3 Railroad Square, Haverhill, Mass.
Lava Tips and Scotch Tips—Charles H. Meyer & Co., 227 Chestnut street, Phil. Pa.
National Tube Works Co., 78 William St., N. Y.
Patent Conically Slotted Wood Trays—John L. Cheesman, 147 and 149 Avenue C., N. Y.
Patent Gas Exhauster—Smith & Sayre, 95 Liberty sttreet.
Pelouze & Audouin Condenser—Jas. R. Smedberg, Sole Agent for U. S. San Francisco, Cal.; Henry Cartwright, 2107 Green street, Phil. Pa.
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Patent Gas Exhauster—S. S. Townsend, Agt., 31 Liberty street, N. Y.

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Gas Coals—Perkins & Job, 27 South st., N. Y.
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Penn Gas Coal Co.—11 Merchants' Exchange, Phil. and 90 Wall street, N. Y.
Peytona Cannel Coal—S. E. Low, 58 Broadway, N. Y.
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Westmoreland Coal Co.—230 South 3rd Street, Phil. Pa.
Youghegheny Coal—Perkins & Job, 27 South St. N. Y.

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Continental Works—T. F. Rowland, Greenpoint.
Camden Iron Works, Camden, N. J.—Jesse W. Starr & Son.
Gloucester Iron Works—J. P. Michelion, Sec., 6 North 7th street, Phila., Pa.
Mill Street Foundry.—Geo. Stacey & Co., Cincinnati, O.
National Foundry and Pipe Works—Wm. Smith, Carroll, Pike, Smallman & Wilkins streets, Pittsburg, Pa.
Oregon Iron Foundry—Herring & Floyd, 740 Greenwich street, N. Y.
Pascal Iron Works—Morris, Taskar & Co., Philadelphia.
Providence Steam and Gas Pipe Co., Providence, R. I.—H. A. Branch, Agent.

WATER METERS, PUMPS, ETC.

Cast Iron Pipes for Water and Gas—Riley A. Brick, 112 Leonard street, N. Y.
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B. Kreischer & Son, Clay Retorts, etc., 58 Goerck st., N. Y.
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Lamps—M. B. Dyott, 114 South 2nd Street, Phil. Pa.
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MISCELLANEOUS.

Analysis and Testing of Gas Coals—Prof. Henry Wurtz, 12 Hudson Torrace, Hoboken, N. J.
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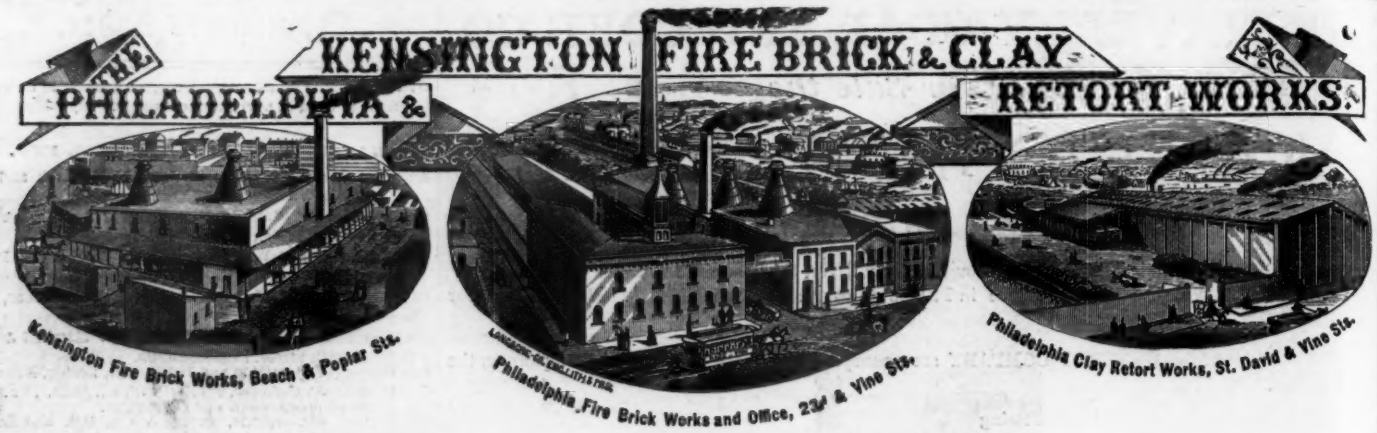
Gas-Light Company of America, 63 and 64 Drexel Building, New York.
Kidd's Gas Consumers Guide—A. M. Callender & Co., 42 Pine Street, N. Y.
Massachusetts Institute of Technology—Samuel Kneeland Boston, Mass.
National Coal Gas Company—H. P. Allen, 4 Warren st., N.Y.
School of Mines, Columbia College, East 49th street.
Screening Shovels—Herring & Floyd, 740 Greenwich street, New York.
Scientific and Practical Chemist and Geologist—Professor Henry Wurtz, 12 Hudson Terrace, N. J.
Screening Shovels—G. W. Dean, 1266 Broadway, N. Y.


THE PHILADELPHIA &
KENSINGTON FIRE BRICK & CLAY
RETORT WORKS.
Kensington Fire Brick Works, Beach & Poplar Sts.
Philadelphia Fire Brick Works and Office, 23d & Vine Sts.
Philadelphia Clay Retort Works, St. David & Vine Sts.

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(SUCCESSOR TO JOHN NEUKUMET),

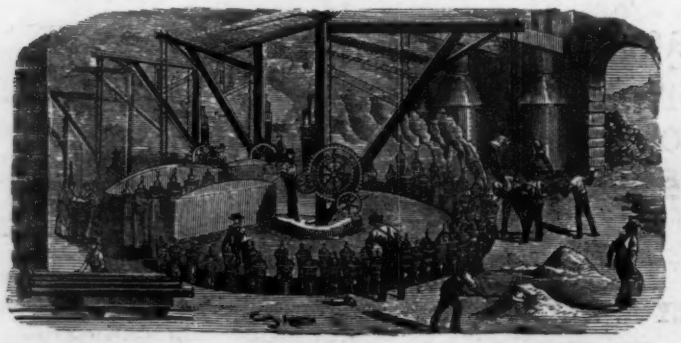
Manufacturer of Fire Bricks, Tiles, Gas and Sugar House Retorts.

☞ Plans of Settings for Benches of Threes, Fives, and Sixes furnished, free of charge, upon application.

M'NEALS & ARCHER,

BURLINGTON. N. J,

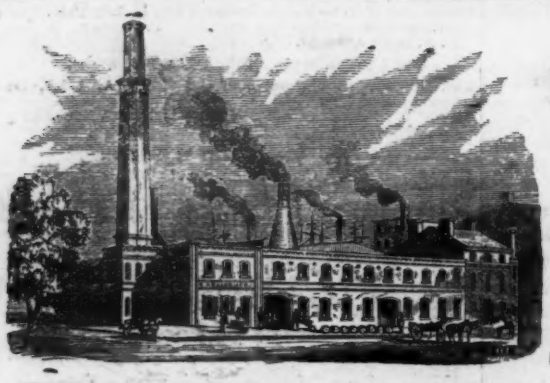
Flange Pipes.



General Foundry Work.

CAST IRON PIPES

FOR WATER AND GAS.



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FIRE BRICK AND CLAY

Retort Works.

☞ *Established in 1845.* ☜

(Branch works at Kreischerville, Staten Island.)

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OFFICE,

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GAS RETORTS, TILES & FIRE BRICK

Of all shapes and sizes.

FIRE MORTAR, CLAY AND SAND.

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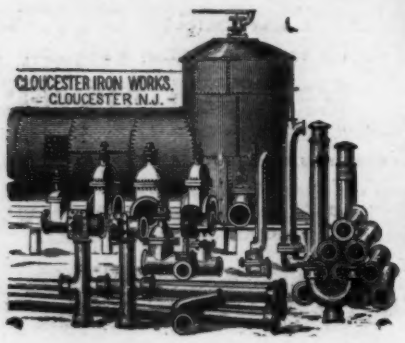

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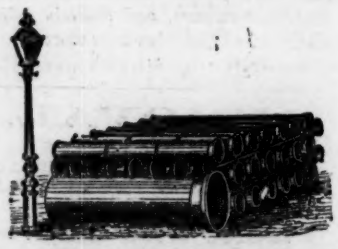

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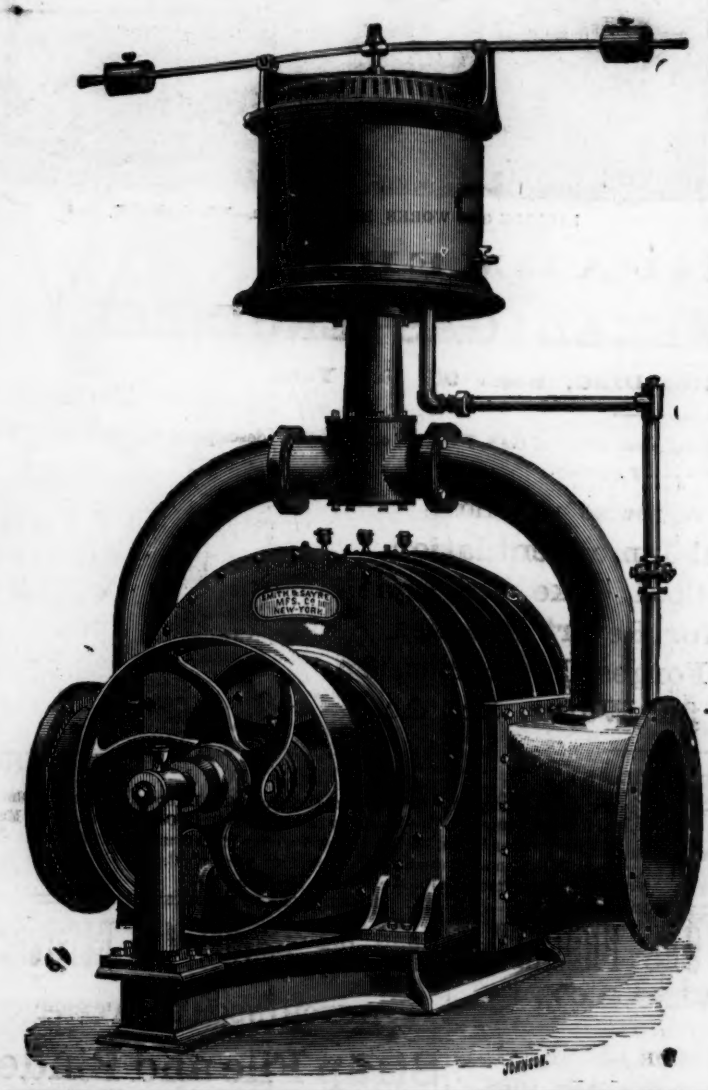

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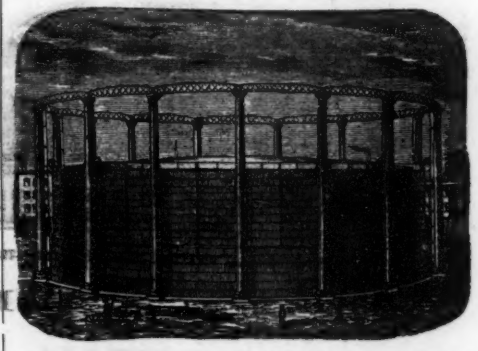

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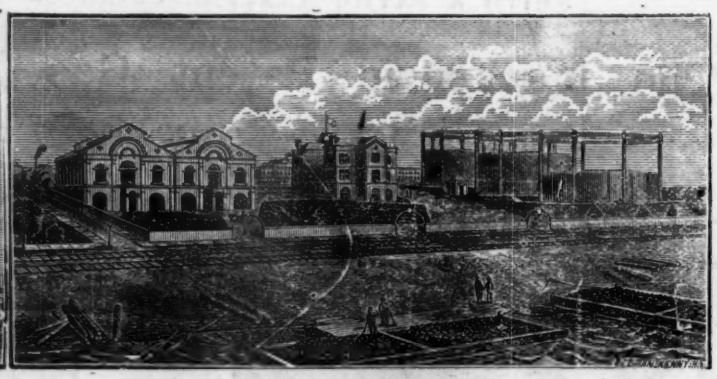

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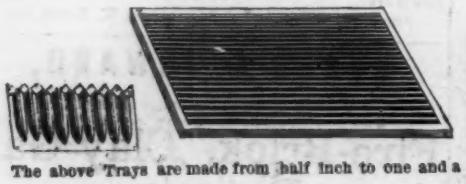

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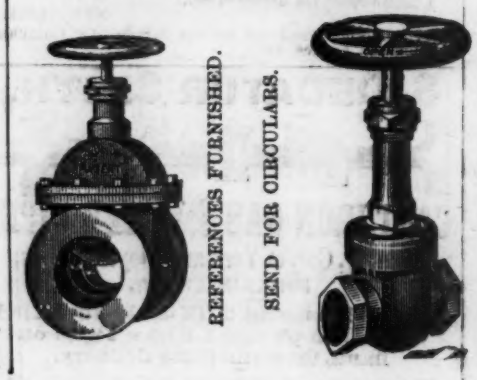

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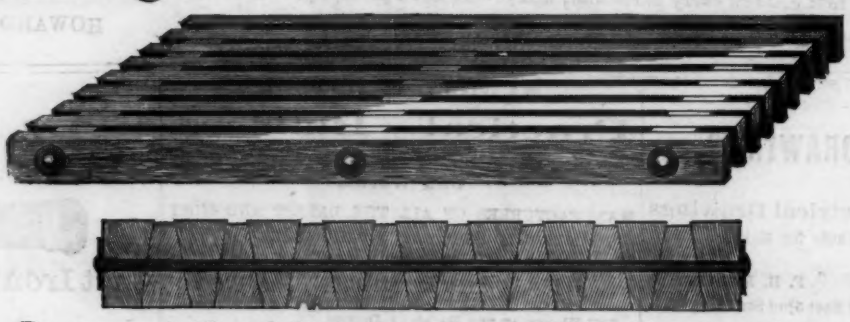

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